(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 623 891 A2**

(12) EUROPEAN PATENT APPLICATION

(21) Application number: **94107061.7**

(51) Int. Cl.[5]: **G06K 9/62**, G06K 9/22

(22) Date of filing: **05.05.94**

(30) Priority: **07.05.93 JP 106638/93**
02.07.93 JP 164487/93

(43) Date of publication of application:
09.11.94 Bulletin 94/45

(84) Designated Contracting States:
DE FR GB IT NL

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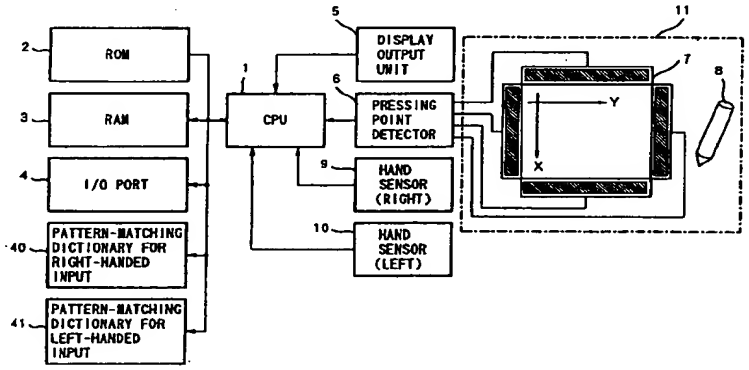
(54) System for adapting the recognition to different users and system for detecting the writing direction.

(57) A hand-held computer with an input pen capable of handwriting recognition. Characters are inputted by a user's manual operation with the input pen on a transparent coordinate input plate in front of a display screen. The computer discriminates pen-input characteristic of the user, and selects a character-recognition dictionary based on the discrimination result.

FIG.1



EP 0 623 891 A2

Fig. 5 illustrates the structure of a pattern-matching dictionary for left-handed input;
Fig. 6 is a flowchart showing an operation procedure of the first embodiment;
Fig. 7 is a block diagram showing the configuration of an information processing apparatus according to a third embodiment of the present invention;
Fig. 8 is a perspective view of the information processing apparatus of the third embodiment;
Fig. 9 is a block diagram showing the configuration of an information processing apparatus according to a fourth embodiment of the present invention;
Fig. 10 is a block diagram showing elements around a coordinate detector according to the fourth embodiment;
Figs. 11 to 13 are explanatory views for the principle of coordinate detection using a resistance film according to the fourth embodiment;
Figs. 14 to 17 are explanatory views for the principle of dominant-hand detection in the fourth embodiment;
Fig. 18 illustrates dominant-hand areas in the fourth embodiment;
Fig. 19 illustrates the relation between a whole image area and a display area in the fourth embodiment;
Fig. 20 illustrates the relation between display directions and displayed contents in the fourth embodiment;
Fig. 21 is a flowchart showing a control procedure according to the fourth embodiment;
Fig. 22 is a block diagram showing the configuration of an information processing apparatus according to a fifth embodiment;
Fig. 23 is a perspective view of the information processing apparatus of the fifth embodiment;
Fig. 24 is a flowchart showing a control procedure according to the fifth embodiment;
Fig. 25 is a block diagram showing the configuration of an information processing apparatus according to a sixth embodiment of the present invention;
Fig. 26 is a block diagram showing the construction of a detector 603 in Fig. 25;
Fig. 27 is a perspective view of the information processing apparatus of the sixth embodiment;
Fig. 28 illustrates the correlation between a display image and the content of a display memory;
Figs. 29A to 29C illustrate conversion examples by a first and second converters of the sixth embodiment;
Fig. 30 is a flowchart showing coordinate detection and output processing according to the sixth embodiment;
Fig. 31 is a perspective view of an information processing apparatus of a seventh embodiment according to the present invention;
Fig. 32 is a cross-sectional view cut out at a line A-A in Fig. 31;
Fig. 33 is a bottom plan view of the information processing apparatus of the seventh embodiment;
Fig. 34 is a cross-sectional view cut out at a line B-B in Fig. 33;
Fig. 35 is a cross-sectional view cut out at a line C-C in Fig. 33;
Fig. 36 is a perspective view of a subordinate apparatus in the seventh embodiment;
Fig. 37 is a cross-sectional view cut out at a line D-D in Fig. 36;
Figs. 38A to 38D illustrate attachment of the apparatus to the subordinate apparatus in the seventh embodiment;
Fig. 39 is a perspective view where the attachment of the apparatus to the subordinate apparatus is completed;
Fig. 40 illustrates the construction of a detector in the seventh embodiment;
Fig. 41 illustrates the relation between logical display space and physical display space in the seventh embodiment;
Figs. 42A to 42D illustrate display directions based on an attachment direction of the apparatus main body with respect to the subordinate apparatus;
Fig. 43 is a flowchart showing coordinate detection and output processing according to the seventh embodiment;
Fig. 44 is a bottom plan view of an information processing apparatus according to an eighth embodiment of the present invention;
Fig. 45 is a cross-sectional view, according to a ninth embodiment of the present invention, cut out at a line E-E in Fig. 36;
Fig. 46 is a perspective view of the apparatus main body, combined with the subordinate apparatus, held upright, in the ninth embodiment;
Fig. 47 is a block diagram showing the configuration of an apparatus main body according to a tenth embodiment of the present invention;
Fig. 48 is a block diagram showing the construction of a power controller in Fig. 47;
Fig. 49 is a block diagram showing the configuration of a subordinate apparatus of the tenth embodiment;
Fig. 50 is a flowchart showing an on/off control procedure of an optical communication plane of the tenth embodiment;
Fig. 51 is a flowchart showing a communication procedure according to the tenth embodiment;
Fig. 52 is a block diagram showing the construction of an electricity interface of the tenth em-

potential between the applied voltages. The pressed-point detector 6 detects a pressed-point on the input tablet 7 from the measured potential level.

Numerals 9 and 10 denote hand sensors which respectively detect whether or not a predetermined pressure is applied on the palm rests 22 and 23. When the user put his/her hand on the palm rest 22 or 23 for inputting, the hand sensors 9 and 10 detect that the palm rest 22 or 23 receives the pressure, and output detection results to the CPU 1. Note that the hand sensors 9 and 10 may detect a temperature and other values as well as the pressure.

Numerals 40 and 41 denote pattern-matching dictionaries used upon character recognition to be described later.

〈Character Recognition (Figs. 3-5)〉

The character recognition by the apparatus according to the first embodiment will be briefly described below. If a state where the user's hand is placed on the palm rest 22 is detected, it is determined that the user has the input pen 8 in his/her right hand. On the other hand, if a state where the user's hand is placed on the palm rest 23 is detected, it is determined that the user has the input pen 8 in his/her left hand. Then, one of the pattern-matching dictionaries 40 or 41 is selected based on the determination result.

Fig. 3 shows a part of a displayed screen image on the display output unit 5 for character-recognition input. In Fig. 3, numeral 30 denotes a character input frame. When the user writes a character within the character input frame 30 on the input tablet 7 with the input pen 8, the character pattern is recognized by the CPU 1 in accordance with, e.g., a pattern-matching method, and outputted to a document file.

The character recognition starts, e.g., at a point where a predetermined period has elapsed from a character pattern was inputted within one input frame, at a point where a predetermined instruction with the pen (character recognition instruction) is made, or at a point where another character was inputted within the next input frame.

Figs. 4 and 5 show the structure of the pattern-matching dictionaries 40 and 41. The dictionary 40 is used for pattern-matching for right-handed input, and the dictionary 41, for left-handed input. That is, the pattern-matching dictionaries 40 and 41 are used so as to have a highest character recognition rate regarding various handwritings by a right-hander and a left-hander.

Next, the processing operation according to the first embodiment will be described with reference to the flowchart in Fig. 6. It should be noted that the program for this operation has already been stored in the ROM 2.

In this embodiment, the pattern-matching dictionary is selected based on the detection results by the hand sensors 9 and 10, i.e., which of the palm rests 22 and 23 is pressed.

In step S101, whether or not coordinate-input has been made is determined. If YES, the process proceeds to step S102, while if NO, returns to step S101 in which input is awaited. Thereafter, when pen-input with the input pen is detected, the process proceeds to step S102 in which character pattern input is made based on the locus of the input coordinates. As character pattern input for one character is completed, the process proceeds to step S103.

In step S103, a pressed/unpressed state of the left palm rest 23 is read from the left hand sensor 10. Similarly, a pressed/unpressed state of the right palm rest 22 is read from the right hand sensor 9 in step S104. In step S105, whether or not the left palm rest 23 is pressed or not is determined based on the state inputted from the sensor 10. If YES, the process proceeds to step S106, while if NO, proceeds to step S107. In step S106, the dictionary 41 for left-handed input is selected, then, the process proceeds to step S110.

In step S107, whether or not the right palm rest 22 is pressed or not is determined based on the state read from the sensor 9. If YES, the process proceeds to step S108, while if NO, proceeds to step S109. In step S108, the dictionary 40 for right-handed input is selected, then, the process proceeds to step S110.

If no pressed state is detected, it can be considered that the sensors do not work, otherwise the user inputs from an inappropriate direction (e.g., from the rear side of the apparatus). In this case, the process does not invalidate the pen-input, but merely outputs an alarm in step S109 and advances to step S110. It should be noted that the pattern-matching dictionary at this time is one used in the previous processing, for with which hand the user holds the input pen cannot be determined.

In step S110, pattern matching is performed based on the input character pattern and the selected dictionary. Then in step S111, the resulting character and its code are outputted at a predetermined position on the display output unit 5.

As described above, according to the present embodiment, the hand sensors 9 and 10 detect the states of the right and left palm rests 22 and 23, and the pattern-matching dictionaries are switched based on the detection results. Accordingly, the user does not have to change any particular setting for selecting a pattern-matching dictionary for right-handed or left-handed input. This enables an information processing apparatus having a higher

pulse signal is applied to the ultrasonic vibrator 14 of the input pen 13 via the cable 26 to drive the vibrator 14. As this pen point 15 is pressed on the input surface of the tablet 18, the ultrasonic wave as elastic wave from the pen point 15 is propagated on the tablet 18, and received by the sensors 16A to 16C. Respective delay times tg between the point where the pen point 15 is pressed on the tablet 18 and the point where the ultrasonic wave is received by the sensors are synchronized with the start signal. The reception waveform detector 19 input the resulting signals and outputs reception waveforms. The arithmetic controller 11 calculates coordinates of the pressed-point by the pen point 15 from the outputs from the reception waveform detector 19.

Numerals 20 and 21 denote a right pen-connector sensor and a left pen-connector sensor for detecting whether or not the pen connectors 24 and 25 is connected with the input pen 13. The CPU 1 detemines which of the right connector 24 and the left connector 25 is connected with the input pen 13 by the pen-connector sensors 20 and 21.

The control procedure by the CPU 1 in this embodiment also follows the flowchart shown in Fig. 6.

That is, in the third embodiment, steps S101 and 102 are corresponding to those in the first embodiment. In steps S102 and S103, signals from the pen-connector sensors 20 and 21 are detected. In steps S105 to S109, a pattern-matching dictionary is selected based on the detection signals from the sensors 20 and 21. Then, in steps S110, character recognition is made using the selected dictionary, and outputting of a character code as a recognition result is made in step S111.

As described above, the third embodiment switches the pattern-matching dictionaries by detecting the position where the input pen is connected, thus attains a similar advantage to the foregoing embodiments.

[Fourth Embodiment]

In an information processing apparatus having a coordinate data input device with an input pen, a first method for specifying an input direction (a direction from which a user makes character-input), is displaying an input-direction selection image for the user to select an input direction, and performing input operation in accordance with the selected input direction. A second method is detecting the inclination of the input pen and specifying the input direction based on the detection result. Note that as a mechanism for detecting the inclination of the input pen, a quicksilver switch may be provided in the input pen, or a light-emitting element and a light-receiving element may be provided in the input pen so that light is emitted from the light-emitting element only when the pen is held at a right angle, and is received by the light-receiving element.

However, the first method requires the user to select an input direction each time the user desires to change the input direction. The second method causes complexity in the construction of the input pen. Further, the second method requires registration of individual input directions, for users have different way of holding the input pen.

The fourth embodiment solves such problems by detecting an individual dominant hand and specifying an input direction based on the detected dominant hand.

Fig. 9 shows a hardware construction of the fourth embodiment. Numeral 101 denotes a resistance-film type digitizer similar to the transparent input tablet 7 of the first embodiment; 102, an ultrasonic-type digitizer similar to the tablet 18 of the third embodiment; 103, an LCD (liquid crystal display); 104, a pen for inputting coordinate data by contacting the digitizer surface; 105, a pen driver for vibrating the pen 104 at a predetermined frequency; and 106, a coordinate detector (dominant-hand detector) for detecting coordinates based on by positions of the pen and the user's hand, for the digitizer 101. The coordinate detector 107 detects coordinates from pen-input the writing style of the pen-input. Numeral 107 denotes a coordinate detector for the digitizer 102, for detecting pen-input coordinates. Numeral 108 denotes an input direction judgment circuit which inputs detection results from the dominant-hand detector 106 and the coordinate detector 107 and judges the input direction; 109, a CPU for controlling the overall apparatus; 110, a display controller for controlling the LCD 103 and a display memory 111; 112, a RAM; and 113, a ROM.

The principle of input-coordinate detection at the resistance-film type digitizer will be described with reference to Fig. 10.

The coordinate input unit has two resistance films 201 and 202 in layers with a spacer such as a silicon rubber having a predetermined thickness between them. Usually these resistance films are not in contact, however, when the coordinate input surface receives a pressing, the films contact with each other at the pressed-point. As shown in Fig. 10, the film 201 have electrodes A and B at its two opposing sides, and the film 202, C and D also at its two opposing sides. These electrodes are connected to the coordinate detector 107 and are provided with a predetermined voltage.

Fig. 11 shows a state where there is no pressing upon the coordinate input surface. When a pressing is made, the two resistance films contact

The input direction judgment circuit 108 makes judgment of the input direction in accordance with the following judgment rules:

(1) If

Vc (=Vd) < Vc' (=Vd'),
Va (=Vb) < Va' (=Vb') and
"the user is right-handed"

or

Vc (=Vd) > Vc' (=Vd'),
Va (=Vb) < Va' (=Vb') and
"the user is left-handed"

The input direction: E in Fig. 18

(2) If

Vc (=Vd) > Vc' (=Vd'),
Va (=Vb) < Va' (=Vb') and
"the user is right-handed"

or

Vc (=Vd) > Vc' (=Vd'),
Va (=Vb) > Va' (=Vb') and
"the user is left-handed"

The input direction: F in Fig. 18

(3) If

Vc (=Vd) > Vc' (=Vd'),
Va (=Vb) > Va' (=Vb') and
"the user is right-handed"

or

Vc (=Vd) < Vc' (=Vd'),
Va (=Vb) > Va' (=Vb') and
"the user is left-handed"

The input direction: G in Fig. 18

(4) If

Vc (=Vd) < Vc' (=Vd'),
Va (=Vb) > Va' (=Vb') and
"the user is right-handed"

or

Vc (=Vd) < Vc' (=Vd'),
Va (=Vb) < Va' (=Vb') and
"the user is left-handed"

The input direction: H in Fig. 18

The input direction judgment result is employed for controlling image display direction on the LCD 103.

Fig. 19 shows the relation between a whole logical image area 301 and a physical display area 302 within the RAM 112. The CPU 109 transfers data within the display area 302 through the display controller 110 to the display memory 111. That is, changing the display direction as shown by numerals 401 to 404 in Fig. 20 is made by changing transfer order of data within the display area or whole image area.

The image display direction control will be described with reference to the flowchart of Fig. 21. Note that the program for this control procedure has already been stored in the ROM 113.

In step S801, input direction judgment by the input direction judgment circuit 108 is made. In step S802, data reading and data conversion in correspondence with the input direction judged in step S801 is selected.

In Fig. 18, if it is determined that the input is in the direction G, all data within the display area 302 of the RAM area 301 is transferred to the display memory 111 without any conversion.

If it is determined that the input is in any of the directions E, F and G, data in the RAM area 601 is read out and corresponding image-turning operation (data conversion) (any of steps S805, S807, and S809) is performed (otherwise, the writing direction in which data is transferred to the display memory 111).

In any case, the process proceeds to step S810, in which the converted data is transferred through the display controller 110 to the display memory 110. In step S811, the display controller 110 outputs data for the display memory 111 to the LCD 103. In this manner, the display direction is changed.

The above operation obtains a display direction in accordance with an input direction from which the user makes pen-input by automatically detecting the input direction and converting data in accordance with the input direction.

The present embodiment detects the positional relation between the pen-contact point P and the hand-contact point Q by comparing the coordinates of the contact point P detected by the digitizer 102 and the coordinates of the contact point Q detected by the digitizer 101. This positional relation may be detected by other means.

It should be noted that if the input surface is too small, pressure sensors provided to the palm rests as described in the first embodiment are advantageous, while if the input surface is large, the arrangement of the fourth embodiment is advantageous.

[Fifth Embodiment]

The fourth embodiment employs the resistance film-type digitizer and the ultrasonic-type digitizer in layers for detecting pen-input coordinates and a hand-contact point, however, the present invention is not limited to this arrangement. In addition, the input-direction judgment result can be utilized for other processings than changing the display direction. The fifth embodiment detects a hand-contact position by switches which work as palm rests on the frame of the display and employs the input-direction judgment result for character recognition. Further, the fifth embodiment makes input-direction judgment in upward/downward directions, at the same time, makes judgment of right-handed/left-handed input of the user.

Fig. 22 shows the hardware configuration of an information processing apparatus according to a

rally form an input-output unit. Numeral 603 denotes a detector which detects the input direction and transfers the detection result to a controller 606; and 604, a display controller which controls display at the output unit 602 based on stored content of a display memory (RAM) 605. Further, the display controller 604 changes the data of the display RAM 605 by an instruction from the controller 606.

The display memory 605 stores data to be displayed at the output unit 602. The controller 606 controls the overall apparatus. Numerals 607 and 608 denote converters for converting data based on the detection result from the detector 603.

Numeral 609 denotes a processor which executes, e.g., an application program; and 610, a memory such as a ROM or a RAM.

Fig. 26 shows in detail the construction of the detector 603.

The information processing apparatus, comprising the input unit and output unit as an integrated input-output unit, has four power-supply systems (DC jacks) at a relatively same position on each side surface. The apparatus is powered when a user inserts a DC plug into any of these power-supply systems. In Fig. 26, the construction of the detector 603 includes these power-supply systems.

In Fig. 26, numerals 651 to 654 denote the DC jacks, each having a power-supply line, a ground line and a display-direction control signal line.

Normally, a power-supply cable to the apparatus is provided on the apparatus rear side, since the cable in front of the user or at a side of the apparatus disturbs the user's operation. That is, detecting a DC jack into which the DC plug is inserted corresponds to specifying an input direction in which the user stands. In this embodiment, when a DC plug 656 is inserted any of the DC jacks 651 to 654, a signal indicative of a display direction corresponding to the DC jack (direction where an image is displayed appropriately to the user) is outputted.

Numeral 655 denotes an AC adapter for connecting the apparatus with a domestic power supply, performing A/D conversion and switching the power-supply lines, the ground lines and the display-direction control signal lines. Numeral 657 denotes the apparatus main body.

Fig. 27 shows the external appearance of the apparatus. Numeral 680 denotes a cabinet to which an input pen 601 is connected with a cable. The DC jacks 651 to 654 are provided on the respective side surfaces of the case member (the DC jacks 653 and 654 are not shown).

Next, the display direction control operation according to the sixth embodiment will be described. Note that a displayed image corresponds to bitmap data in the display memory 605. More specifically, each dot information written in the display memory 605 coincides with a dot at relatively the same position in the displayed image which is turned on. Fig. 28 shows the correlation between a display image of the output unit 602 and the content of a display memory 605. It should be noted that though the illustration is simplified, an actual number of dots in the display image is greater for representing a complicated figure or a sentence having a predetermined length. In Fig. 28, the number of dots in a horizontal direction is "a", and that in a vertical direction is "b".

Assuming that the DC plug 656 is inserted into any of the DC jacks 651 to 654, the apparatus is provided with electricity, and at the same time, one of display direction control signals P, Q, R and S is transferred to the converters 607 and 608. The converters perform conversion upon the input data in accordance with corresponding one of the following equations. More specifically, The converter 607 converts coordinate data inputted from the input unit 601, while the converter 608 converts coordinate data to be outputted to the output unit 602. Note that the converters perform no conversion when the signal P is at a high level.

(1) If the signal $\underline{Q}$ is high,

$$bit(x, y) = bit(int\{a/b(b-yin)\},int\{b/a \cdot xin)\} \quad ①$$

$$bit(xout,yout) = bit(int\{a/b \cdot y\},int\{b/a(a-x)\}) \quad ②$$

(2) If the signal R is high,

$$bit(x, y) = bit(int\{a-xin\},int\{b-y\}) \quad ③$$

$$bit(xout,yout) = bit(int\{a-x\},int\{b-y\}) \quad ④$$

(3) If the signal S is high,

$$bit(x, y) = bit(int\{a/b \cdot yin\},int\{b/a(a-xin)\}) \quad ⑤$$

$$bit(xout,yout) = bit(int\{a/b(b-y)\},int\{b/a \cdot x\}) \quad ⑥$$

(xin, yin) are coordinates at the input unit 601; (x, y), at the controller 606 and the processor 609; and (xout, yout), at the output unit 602. a and b represent an image size; and int(a/b•y), an integral portion of an operation (a/b)•y. Figs. 29A to 29C show coordinate conversions respectively corresponding to the above equations.

The display direction control of the present embodiment will be described with reference to the flowchart of Fig. 30. Note that the program for this operation is stored in a ROM (not shown) of the memory 610.

First, when the power of the apparatus is turned on, which of the signals P to S is high is

wise direction of the apparatus main body, and at the four corners of the bottom plate 703, grooves 904a to 904 and rubber feet 905a to 905d for catching the cord 709 are provided. Note that the height of the convex portions 803a to 803d is shorter than that of the rubber feet 905a to 905d.

Fig. 34 shows a cross-section of the concave portion 901 cut out at the line B-B in Fig. 9. Note that the cross-section of any of the other concave portions 902, 906 and 907 is identical to that of the concave portion 901. The four concave portions 901, 902, 906 and 907 respectively have openings 901a, 902a, 906a and 907a provided on one of their four side surfaces, and the openings 901a, 902a, 906a and 907a respectively have a flat springs 1001a to 1001d. Fig. 35 shows the cross-section of the concave portion 901 cut out at the line C-C in Fig. 33. The openings 901a, 902a, 906a and 907a respectively have an electrode 1101 comprising two electrode pins 1101a, 1101b, 1101c and 1101d. The concave portions 901, 902, 906 and 907 are respectively provided at a corresponding position with respect to the side surfaces.

Next, the construction of the digitizer 704 will be described below. Though various methods are applicable as coordinate detection by a digitizer, the present embodiment employs an ultrasonic-wave detection method, since this method uses a glass plate as a coordinate input plate, through which the user can clearly see an image displayed at the LCD. However, any detection method to which a transparent material can be applied may be employed.

When the input pen 705 which incorporates a vibrator is brought into contact with the coordinate input plate (vibration propagating plate), the vibration having the contact point as its center is detected by a plurality of vibration sensors fixed around the vibration transmitting plate. The time that each sensor takes for detecting the vibration depends on a distance between the sensor and the contract point, the distance between the contact point and each sensor can be obtained by measuring time from a point where the input pen contacts the input plate to a point where each sensor detects the vibration. Thus, the input coordinates can be geometrically calculated. Note that the vibration transmitting plate is provided with a vibration-proof member which reduces vibration around its sides, so as to absorb vibration reflected from the ends of the vibration transmitting plate. Further, the vibration transmitting plate is also provided with a detector for detecting signals from the respective vibration sensors and measuring transmission time.

Next, the construction of the subordinate apparatus will be described below.

Fig. 36 shows the external appearance of the subordinate apparatus of the seventh embodiment. The subordinate apparatus is a substantial rectangular parallelepiped having two substantially-L-shaped side surfaces at the shorter sides as right and left. The apparatus comprises a resin upper case 1201, having a rectangular-parallelepiped convex portion 1201a on one side of its upper surface 1201b, and a lower case 1202. The width of this subordinate apparatus substantially coincides with that of the apparatus main body. The upper case 1201 further has a hook 1203 and engaging member 1204, optical-communication windows 1205a to 1205g on the upper surface 1201b. The engaging member 1204 is biased to the upper side by a spring (not shown), and when it receives a predetermined force, it moves to the lower side. The optical-communication windows 1205a to 1205g are arranged in a L-shape, specifically, the windows 12025a to 1205d are in the vertical direction (a direction parallel to the shorter sides) and the windows 1205d to 1205g are in the horizontal direction (a direction parallel to the longer sides, with the convex portion side as the top parallel to the longer sides . Further, the upper case 1201 has a release button 1206 which removes the apparatus main body from the subordinate apparatus, and LED 1207a and 1207b which are indicators for the power and FDD operation, on the convex portion 1201a. When the release button is pressed, an incorporated rotating mechanism (not shown) and sliding mechanism (not shown) move the engaging member 1204 downward. The convex portion 1201a has guide pins 1208a and 1208b respectively at around the right and left sides of its inner side surface (surface contacting the upper side of the upper surface 1201b), and a operation pin 1209, for attachment-state detection to be described later, around the guide pin 1208a. One of the L-shaped side surfaces (right side surface) has a slot of an incorporated FDD 1210. An I/O port, a network I/F, a keyboard connector and a DC jack (all not shown) are incorporated at the other L-shaped side surface side (left side surface).

Fig. 37 shows the cross-section of the hook 1203 cut out at the line D-D in Fig. 36. The upper case 1201 has a print board 1301 on which a CPU for controlling the overall subordinate apparatus, a memory and a optical communication device are mounted. An electrode 1302, which has two electrode pins 1302a and 1302b (not shown) respectively biased by a spring (not shown), is provided at the inside of the hook 1203.

Next, the attachment/detachment of the apparatus main body to the subordinate apparatus will be described with reference to Figs. 38A to 38D.

In this case, the apparatus main body is used with the shorter side at the top.

is the left side surface when the apparatus main body is used with the shorter side at the top. The current right side surface of the apparatus main body (top side surface when the apparatus is used with the shorter side at the top) and the right L-shaped side surface of the subordinate apparatus becomes substantially the same surface. In this attachment, the positional relation between the guides 1501a, 1501b and the guide pins 1208a, 1208b, the relation between the concave portion 902 and the hook 1203 of the subordinate apparatus and attaching movements are similar to those in attachment for the use with the shorter side at the top. That is, the positions of guides 1501c, 1501d and the concave portion 902 for the use with the longer side as top correspond with the guides 1501a, 1501b and the concave portion 901 for the use with the shorter side at the top. Further, the positions of the optical communication windows 903a to 903d correspond with those of the optical communication windows 1205d to 1205g. As the window 1205d is positioned at an intersection point of the vertically arranged windows and the horizontally arranged windows, it can be used in the both cases where the apparatus main body is used with shorter side at the top, and with the longer side at the top.

In the above both cases, when the combined information processing apparatus is placed on a horizontal surface such as a desk, the input surface is slanted with a predetermined angle. Note that the separating is made by pressing the release button 1206 to move the engaging member 1204 downward.

It should be noted that the aforementioned two attachment cases respectively correspond to the other two attaching directions, i.e., the apparatus main body and the subordinate apparatus can be attached and detached in cases where the apparatus main body is used with the other shorter side at the top and the other longer side at the top.

In the above-described attachment and detachment of the apparatuses, the convex portion 1201a of the subordinate apparatus works as an attaching/detaching guide when the apparatuses are moved relatively to each other, since the user can hold the convex portion 1201a during these manual attaching/detaching operations. Thus, the attachment and detachment of the apparatuses can be easily made.

Fig. 40 shows an example of a detector for detecting an input direction. In Fig. 40, numerals 1601 to 1604 denote pull-down resistances.

Assuming that the apparatus main body is combined with the subordinate apparatus for using the apparatus main body with the shorter side at the top, one of the four electrodes 11011a to 1101d conducts electricity, and corresponding one of the signals P to Q is transferred to the converter 107 and the converter 108 of the apparatus main body.

In the sixth embodiment, a user or an application software adjusts the size of one pixel based on the resolution of the output unit 602. For example, in a case where the output unit 602 represents an image with 200 (vertical) × 400 (horizontal) dots, and each dot is represented by coordinates (x, y) ($X \leq 400$, $Y \leq 200$), if the input direction is shifted by 90° from the user, still the image is represented by the coordinates for the 200 × 400 dots, which means that one pixel is doubled in the vertical direction and reduced to half in the horizontal direction. This does not change content of the information, but changes aspect ratio of the displayed information. Alternatively, the aspect ratio may be maintained even if the displayed content is changed, which means that the measurements of one dot may be the same with respect to all direction. Description of this displaying method will be made in detail below.

Fig. 41 shows the relation between a whole image area (logical display space) 1701 and a display area (physical display space) 1702 in the RAM of the memory 610. To display an image, the controller 606 transfers data in the display area 1702 through the display controller 604 to the display memory 605. Accordingly, it can change the display image by changing transfer order of the data in the display area 1702. The display direction at the display area 1702 is determined based on an attachment direction of the apparatus main body as an in put direction.

In a case where data in the display area 1702 is as shown in Fig. 41, the data is displayed in accordance with the attachment direction of the apparatus main body, as shown in Figs. 42A to 42D. Note that in these states, the apparatus main body is positioned in the same direction, however, connecting directions of the subordinate apparatus with respect to the apparatus main body are different. In Fig. 42A, the user stands in the lower direction, as pointed by an arrow 4201; in Fig. 42B, in the left direction as pointed by an arrow 4202; in Fig. 42C, in the upper direction pointed by an arrow 4203; and in Fig. 42D, in the right direction pointed by an arrow 4204. As it is apparent from Figs. 42A to 42D, an image having the same measurements in a proper direction to the user can be obtained without considering a setting direction of the apparatus main body, simply by placing the subordinate apparatus with the convex portion 1201a at the top when attaching the apparatuses.

Fig. 43 shows the display-direction control procedure according to the seventh embodiment. It should be noted that operations substantially correspond to those in Fig. 30 have the same reference numerals (steps S601 to S611). In this proce-

As shown in Fig. 45 which is a cross-section cut out at the line E-E in Fig. 36, the bottom surface of the apparatus main body may comprise of rubber feet 1212 at its both sides. Note that rubber material is employed to prevent vibration of the apparatus. Further, the rear side surface of the subordinate apparatus (side surface of the convex portion 1201a, opposite to the side surface having the guide pins 1208a and 1208b) may comprise of a stand 1224 to stabilize the combined apparatus when it stands upright. As shown in Fig. 45, the stand 1224 rotates at 180° or greater angle with respect to the rear side surface of the subordinate apparatus, and as shown in Fig. 46, the display of the apparatus main body is slanted with the upper surface facing upward. Note that the both right and left side surfaces of the subordinate apparatus comprise a rubber foot 1213 to stabilize this state and prevent vibration (the stand 1224 is provided between the rubber feet 1213).

In the state as shown in Fig. 46, to avoid displaying an image upside-down, a detection switch (not shown) for detecting the rotational movement of the stand 1224 is provided. As the CPU of the apparatus main body cannot recognize that this standing state of the apparatus by itself, it receives a detection signal from the above detection switch. The signal may be supplied to the main body with an optical signal or via a dedicated contact terminal. When this switch is turned on, the CPU controls the display direction so as to turn over an image properly.

[Tenth Embodiment]

When the apparatus main body is mounted on the subordinate apparatus, the electrodes other than that actually connected to the subordinate apparatus (electrode that receives electric power from the subordinate apparatus) are not connected. Preferably, those unused electrodes are covered with a shutter or a lid, however, such protection causes complexity of the mechanism, and above all, a user has to manually cover the electrodes at every connecting operation.

However, if the user touches the naked electrodes or inserts something into those portions, the unused electrodes might generate heat due to accidental electric shock or short circuit.

Further, even if these electrodes are covered, an incoming noise might enter the electrodes and cause erroneous operation of the apparatus.

Accordingly, the tenth embodiment activates only the electrode that is connected with the subordinate apparatus and deactivates the other electrodes to solve the above problems.

Fig. 47 shows the configuration of an apparatus main body according to the tenth embodiment.

A CPU 2010 which controls the overall apparatus main body is a 32-bit CPU, e.g., i80386SL by Intel Corporation. The CPU 2010 executes programs for calculation, I/O control and so on. A peripheral chip set 2011 is used with the CPU 2010 for necessary peripheral I/O controls (serial communication, parallel communication, real-time clock control, timer control, interrupt control etc.). A memory 2012 includes a main memory (8MB DRAM), a cache (64KB) and a boot ROM. The main memory is backed up while it is suspended. An HDD 2013 is a 1.8 or 1.3 inch hard disk, used for storing an OS, application software, user data etc. (the capacity is 20-80MB).

The information processing apparatus of the present embodiment is a hand-held computer. Input is made using a pen 705 upon a digitizer 704 as if characters are written on a sheet of paper, and its locus and input result are displayed on an LCD 801. The LCD 801 and the digitizer 704 are arranged in layers so that an input position and an output position coincide. The input precision of the digitizer 704 is at least equal to or higher than the LCD display precision, e.g., 0.1 mm. A digitizer controller 2014 comprises a CPU, a ROM, a RAM for controlling the digitizer 704.

An LCD controller 2017 sequentially accesses display data from a VRAM 2018, then transfers the data, taking tone-levels into account, to an LCD 2019, and at the same time, performs bus control so as to avoid access conflict between access from the CPU 2010 to the VRAM 2018 and access from the LDC controller 2017 to the LCD 2019. Further, the LCD controller 2017 can perform logic operations such as AND, OR, EXOR upon the display data in the VRAM 2018 with predetermined data, using e.g. a VGA controller. A backlight 2021, provided under the LCD 801, comprises light-emitting elements for emitting light so that the displayed content on the LCD 801 is visible at indoors or poor-light places. For the backlight 2021, e.g., an EL (electroluminescence) method or a CFL (XXXXXX) method may be used. A backlight inverter 2020 drives the light-emitting elements.

A card I/F 2023 accepts memory cards such as a ROM-extension memory card for adding application programs and data, a RAM card for backup operation, and a flash memory card for backup operation and for adding data, further, I/O cards such as a facsimile data modem card for data communication via a telephone line and a LAN card for connecting the apparatus to a network. It should be noted that the I/F employed in this embodiment is based on a sixty-eight pin standard decided by the JEIDA/PCMCIA (XXXXXXXXX) that is becoming popular (any other I/F standard can be employed). A card controller 2022 performs control for writing data from the CPU into the cards and

First, the connection detection switch is checked in step S205. If the connection between the apparatuses is confirmed, the process enters a communication routine in step S206. If the connection is not confirmed in step S205, it is judged that the apparatus main body and the subordinate apparatus are apart from each other. In this case, parameters necessary for communication are backed up in step S207, the optical communication plane is turned off, and the communication flag is turned off in step S208. Then the process ends and does not enter the communication routine till the communication flag is turned on.

When the power is turned on, not shown, the connection detection switch is checked while the power is initialized. If the connection is confirmed, the optical communication plane is turned on, the communication controller is initialized, and the communication flag is turned on.

Next, various usages of the apparatus main body will be described below. As described above, the apparatus main body can be used from the four (or two) directions.

When the pen 705 is used for input, the cord 709 can preferably be positioned at the right side when a user is right-handed, while it is positioned at the left side when the user is left-handed. In the present embodiment, the cord 709 kept at a gap between the pen holder 706 and the side surface of the apparatus main body may be pulled out in accordance with necessity, and it may be held with any of the grooves 904a to 904d, from thereafter, it may further be pulled to the input surface side, thus avoiding hindrance to pen-input by this cord.

Next, usage upon connecting the apparatus main body with the subordinate apparatus will be described below. It should be noted that the present embodiment also provides the subordinate apparatus with rubber feet as described in the ninth embodiment.

In both cases of using the apparatus with the shorter side at the top and using the apparatus with the longer side at the top, the subordinate apparatus is placed under the apparatus main body. The input surface is slanted, i.e., by the rubber feet 1212 of the subordinate apparatus, which helps the user to see the display screen and to input with the pen 705. Further, in the both cases, the combined apparatus can be used in an upright state with the bottom surface of the subordinate apparatus as the bottom of the combined apparatus, as shown in Figs. 39 and 46.

In a case where the direction of display image is turned at 180° by attaching the apparatus main body to the subordinate apparatus, to avoid upside-down display of an image on the LCD 801, the display direction is turned at 180° in correspondence with the rotation of the stand 1224 detected by the detection switch. Note that any other detecting device can be replaced with this switch so far as the upright state of the apparatus can be detected.

〈Electric Interface (Fig. 52)〉

Next, electric power supply from the subordinate apparatus to the apparatus main body will be described with reference to Fig. 52 showing the construction of the electrode contact 2035 (Fig. 47). For the purpose of simplification, the rear surface of the apparatus main body is as shown in Fig. 44, i.e., in only two attachment directions of the apparatus main body with respect to the subordinate apparatus. However, those skilled in the art will easily understand the electric power supply operation in all four directions from the following description.

In Fig. 52, numeral 2088 denotes an electrode contact unit provided within the concave portion 901 on the bottom surface of the apparatus main body, which supplies electric power to the apparatus main body when the apparatus main body is connected to the subordinate apparatus with the longer side of the main body at the top. Similarly, an electrode contact unit 2089, provided within the concave portion 902 on the bottom surface of the apparatus main body, supplies electric power to the apparatus main body when the connection is made with the shorter side of the apparatus main body at the top.

Numeral 2080 denotes an electrode contact provided within the concave portion 901; and 2081, an electrode contact provided within the concave portion 902. When the apparatus main body and the subordinate apparatus are connected, operation power is supplied via any of the electrode contact 2080 and 2081 from the subordinate apparatus to the apparatus main body. Numerals 2084 and 2085 denote FET switches respectively for turning on and off the current from the electrode contacts 2080 and 2081; 2082, an electrode contact switching signal for switching the on/off operation of the FET switches 2084 and 2085 in accordance with output from the peripheral chip set 2011. Numerals 2082 and 2083 denote connection detection switches for detecting connection between the apparatuses. Outputs from the connection detection switches 2082 and 2083 are OR-connected.

Numeral 2086 denotes a differential circuit which generates a pulse when the outputs from the connection detection switches 2082 and 2083 change; and 2087, a waveform corrector which transforms the output from the differential circuit 2086 into a waveform of TTL (transistor-transistor logic) level. The output from the waveform corrector 2087 is connected to an interrupt of the periph-

is connected with the longer side at the top, is turned off in step S253.

On the other hand, if the content of the display direction byte is "01", i.e., the apparatus main body is connected with the longer side at the top, the FET switch 2085 within the concave portion 901 is turned on in step S254, and, the FET switch 2084 within the concave portion 902 is turned off in step S255.

In the above example, the content of the display direction byte is "00" and "01". However, when the bottom surface of the apparatus main body is for connection in four directions, as shown in Fig. 33, the content of the display direction byte is "00", "01", "10" and "11". In this case, the number of the FET switches may simply be doubled, therefore, the explanation of this case will be omitted.

As described above, according to the tenth embodiment, detection of display direction upon connecting the apparatus main body with the subordinate apparatus enables switchover of an electrode contact to be activated without any specific manual setting. This reduces erroneous operation due to noise entered an unused electrode contact. Further, even in a case where the user carelessly touches the unused electrode contact or inserts something into the electrode contact, abnormally generating heat due to accidental electric shock or short circuit can be prevented. Further, this construction does not require a shutter or lid to cover the unused electrode, thus avoiding mechanical complexity and realizing downsizing and weight reduction of apparatus.

The tenth embodiment activates an electrode to be used and deactivates an unused electrode in accordance with display direction designated by an user. However, as described in the sixth and seventh embodiments, the connecting direction of the apparatus main body may be automatically detected.

This embodiment employs FET switches as control devices, however, the embodiment may also employ other devices such as an electronic relay and a lead switch. Further, the state signals from respective switches may be read.

Moreover, the tenth embodiment is described as to power supply electrodes, however, these electrodes may be used for communication between the apparatus main body and the subordinate apparatus via an electrically connected interface, instead of optical communication. That is, the number of the electrical interfaces in this case corresponds to connecting directions of the apparatus main body with respect to the subordinate apparatus, and only one interface in use is activated and the other interfaces are deactivated.

[Eleventh Embodiment]

The eleventh embodiment detects a connecting direction of the apparatus main body with respect to the subordinate apparatus and switches communication lines.

In this embodiment, the information processing apparatus has a construction identical to that of the foregoing embodiments and therefore the explanation of the construction will be omitted.

〈Connecting Direction Detection Mechanism〉

Figs. 56A and 56B show the electrode contact of the apparatus main body, and Fig. 56C, that of the subordinate apparatus.

In Fig. 56A, the concave portion 902 of the apparatus main body has electrode contacts 150a and 150b, a connection detection switch 152 and a direction detection pin 160. In Fig. 56B, the concave portion 901 of the apparatus main body has electrode contacts 151a and 151b and a connection detection switch 153. In Fig. 56C, the hook 1203 of the subordinate apparatus has electrode contacts 119a and 119b, and a direction detection switch 161. The electrode contacts 119a and 119b are connected with the electrode contacts 150a and 150b or the electrode contacts 151a and 151b, to supply operation power to the apparatus main body. When the apparatus main body is connected, with the shorter side at the top, to the subordinate apparatus, the direction detection switch 161 detects the connecting direction by being pressed with the direction detection pin 160. The output from the direction detection switch 161 is connected to the peripheral chip 2051, from which the CPU 2050 reads the connection state.

〈Optical Communication Interface〉

Fig. 57 shows in detail the arrangement of the optical communication elements in the subordinate apparatus as shown in Fig. 36. In Fig. 57, numerals 1205a, 1205c, 1205e and 1205g denote LED windows for passing infrared signals; and 1205b, 1205d and 1205f, photodetector (hereinafter abbreviated to "PD") windows for receiving the infrared signals as electric signals. When the apparatus main body is connected, with the shorter side at the top, to the subordinate apparatus, the windows 1205a, 1205b, 1205c and 1205d perform optical communication, on the other hand, when the apparatus main body is connected, with the longer side at the top, to the subordinate apparatus, the windows 1205g, 1205f, 1205e and 1205d perform communication.

Fig. 58 shows the construction of the optical communication portion of the subordinate appara-

3. The electronic apparatus according to Claim 1, wherein said discrimination means detects whether the user is a right-handed or left-handed, and wherein if said discrimination means detects that the user is right-handed, said selection means selects a character recognition dictionary for right-handed input, while if said discrimination means detects that the user is left-handed, said selection means selects a character recognition dictionary for left-handed input.

4. The electronic apparatus according to Claim 3, further comprising palm rests respectively for right hand and left hand, wherein said discrimination means detects which of the palm rests the user's hand has been placed on.

5. The electronic apparatus according to Claim 1, wherein said discrimination means discriminates a user based on a writing pressure.

6. The electronic apparatus according to Claim 5, further comprising memory means for storing relation between the writing pressure and the character recognition dictionary for the user, wherein said selection means refers to a dictionary corresponding to the writing pressure used by said discrimination means.

7. A control method for an electronic apparatus which performs handwriting recognition, comprising:

a discrimination step of discriminating a user who performs handwriting input;

a selection step of selecting one of dictionaries for character recognition, based on a discrimination result in said discrimination step; and

a character recognition step of performing character recognition by referring to the dictionary selected by said selection means.

8. The method according to Claim 7, wherein said electronic apparatus is a hand-held computer with an input pen.

9. The method according to Claim 7, wherein in said discrimination step, whether the user is right-handed or left-handed is detected, and wherein if it is detected in said discrimination step that the user is right-handed, a character recognition dictionary for right-handed input is selected in said selection step, while if it is detected in said discrimination step that the user is left-handed, a character recognition dictionary for left-handed input is selected in said selection step.

10. The method according to Claim 9, wherein said electronic apparatus comprises palm rests respectively for right hand and left hand and sensors respectively provided at the palm rests, and wherein in said discrimination step, which of the palm rests the user's hand has been placed is detected.

11. The method according to Claim 7, wherein in said discrimination step, a writing pressure is detected.

12. The method according to Claim 7, wherein said electronic apparatus further comprises memory means for storing relation between the writing pressure and the character recognition dictionary for the user, and wherein in said selection step, a dictionary corresponding to the writing pressure detected in said discrimination step is referred to.

13. An electronic apparatus having input means for manually designating a desired position, comprising:

display means for displaying an image;

detection means for detecting a direction in which a user stands; and

display direction changing means for changing a display direction of said display means, based on a detection result from said detection means.

14. The electronic apparatus according to Claim 13, further comprising character recognition means for changing coordinate data of a handwritten character inputted by said input means at any time when said display direction changing means changes the display direction, and performing character recognition.

15. The electronic apparatus according to Claim 13, being a hand-held computer with an input pen.

16. The electronic apparatus according to Claim 13, wherein said input means is a pen having a vibrator which vibrates when receiving a predetermined driving signal at a pen point, and wherein said detection means has first and second coordinate input means, and detects the direction in which the user stands, based on the coordinate data obtained by said first and second coordinate input means, further wherein said first coordinate input means comprises:

a substantially transparent plate provided in front of a display surface of said display means;

tion result by said detection means;

first conversion means for converting a coordinate data inputted by said coordinate input unit into coordinate data of a coordinate system corresponding to the direction in which the user stands detected by said detection means;

coordinate data supply means for supplying the coordinate data converted by said first conversion means to a higher-leveled processing; and

second conversion means for converting the coordinate data, resulted from the higher-leveled processing, into coordinate data of the coordinate system of the coordinate input unit,

wherein said electronic apparatus performs processing designated by the higher-leveled processing, in accordance with the coordinate data converted by said second conversion means.

26. The electronic apparatus according to Claim 25, being a hand-held computer with an input pen.

27. The electronic apparatus according to Claim 25, wherein respective side surfaces of said apparatus have a connector for receiving electric power, and wherein said detection means discriminates which connector receives the electric power, and detects the direction in which the user stands, based on the discrimination result.

28. The electronic apparatus according to Claim 25, wherein the higher-leveled processing is an application program.

29. The electronic apparatus according to Claim 25, wherein said coordinate input unit has a substantially transparent coordinate-input plate provided in front of a display surface of said display unit and a pen for designating a desired position on the coordinate-input plate.

30. The electronic apparatus according to Claim 29, further comprising a cable for connecting the pen with the electronic apparatus main body, wherein said detection means detects the direction in which the user stands by determining to which connector the cable has been connected.

31. A control method for an electronic apparatus which has a coordinate input unit and a display unit, for performing a predetermined processing, comprising:

a detection step of detecting a direction, in which a user stands, with respect to said coordinate input unit;

a display direction changing step of changing a display direction of an image display by said display unit, based on a detection result in said detection step;

a first conversion step of converting coordinate data inputted by said coordinate input unit into coordinate data of a coordinate system corresponding to the direction in which the user stands detected in said detection step;

a coordinate data supply step of supplying the coordinate data converted in said first conversion step to a higher-leveled processing; and

a second conversion step of converting the coordinate data resulted from the higher-leveled processing into coordinate data of the coordinate system of said coordinate input unit,

wherein said electronic apparatus performs processing designated by the higher-leveled processing, in accordance with the coordinated data converted in said second conversion step.

32. The method according to Claim 31, wherein said electronic apparatus is a hand-held computer with an input pen.

33. The method according to Claim 31, wherein respective side surfaces of said apparatus have a connector for receiving electric power, and wherein in said detection step, which connector receives the electric power is discriminated and the direction in which the user stands is detected based on the discrimination result.

34. The method according to Claim 31, wherein the higher-leveled processing is an application program.

35. The method according to Claim 31, wherein said coordinate input unit has a substantially transparent coordinate-input plate provided in front of a display surface of said display unit and a pen for designating a desired position on the coordinate-input plate.

36. The electronic apparatus according to Claim 31, further comprising a cable for connecting the pen with the electronic apparatus main body, wherein in said detection step, the direction in which the user stands is detected by determining to which connector the cable has been connected.

tion result in said detection step.

46. The method according to Claim 45, wherein a bottom surface of said hand-held computer has optical signal transmission means for transmitting and receiving data, and wherein said functional extension device also has optical signal transmission means at a position opposing to said optical signal transmission means of said hand-held computer.

47. The method according to Claim 45, further comprising:

a first conversion step of converting coordinate data inputted by said coordinate input pen into data of a coordinate system corresponding to the connecting direction detected in said detection step;

a coordinate data supply step of supplying the coordinate data converted in said first conversion step to a higher-leveled processing;

a second conversion step of converting the coordinate data resulted from the higher-leveled processing into coordinate data of the coordinate system of the coordinate input unit; and

a processing step of performing processing designated by the higher-leveled processing in accordance with the coordinate data converted in said second conversion step.

48. The method according to Claim 45, wherein said functional extension device has a size smaller than that of said hand-held computer so that said hand-held computer is slanted at a predetermined angle when said computer is connected to said functional extension device.

49. The method according to Claim 45, wherein in said display direction changing step, the display direction is changed so that an upper side of said slanted hand-held computer becomes an upper side of a display image of said display unit.

50. The method according to Claim 49, wherein said functional extension device further comprises:

upright-state holding member for opening and closing to predetermined angles to stabilize said hand-held computer which stands upright with being connected to said functional extension device and to maintain an upright state of said computer;

state detection means for detecting opening/closing state of said upright-state holding member; and

output means for outputting a detection result by said state detection means to said hand-held computer,

and said method further comprises an inversion step of inverting the upper side and lower side of the display image determined by said display direction changing means.

51. The electronic apparatus system according to Claim 45, further comprises a control step of, when said hand-held computer is connected with said functional extension device in a direction, setting electrical terminals which are used upon connection in another direction into a deactivated state.

52. The method according to Claim 45, wherein said functional extension device comprises a floppy disk drive, a keyboard connector, a network interface and a printer interface.

FIG.2

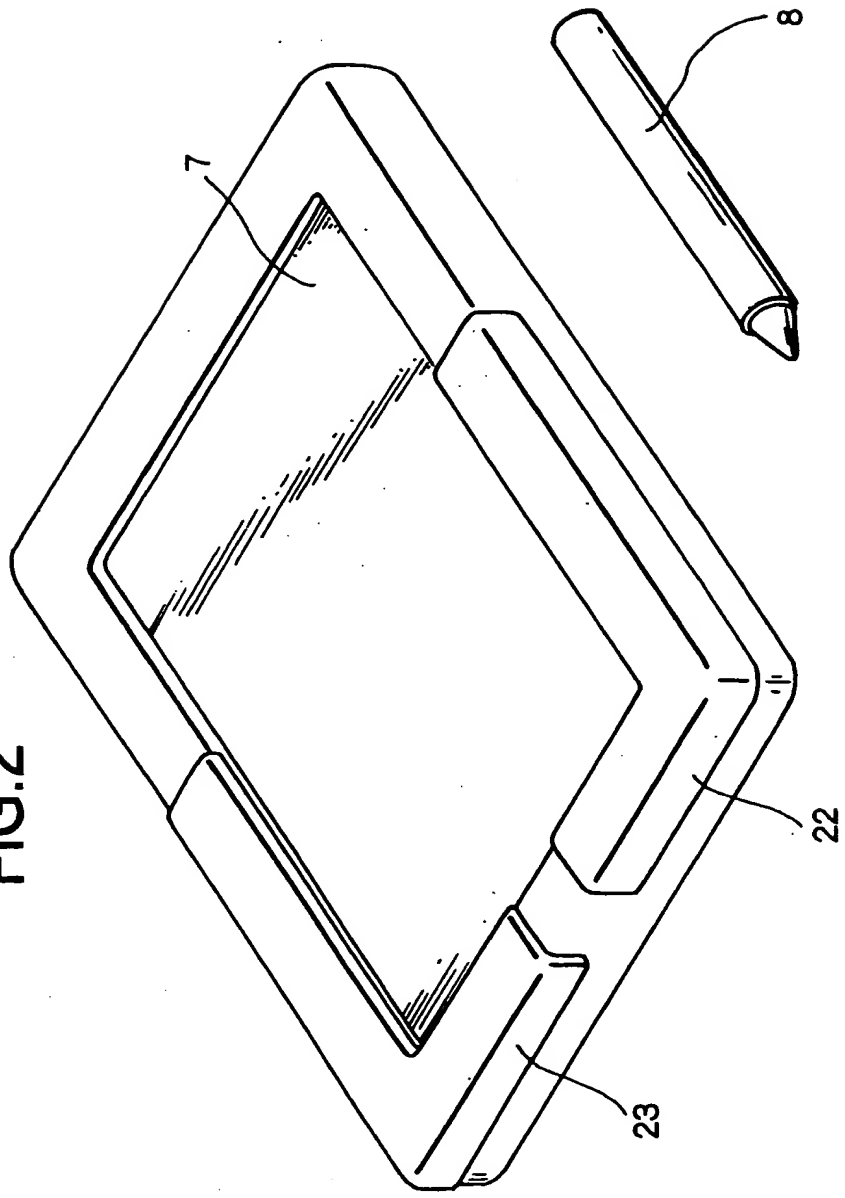


FIG.4

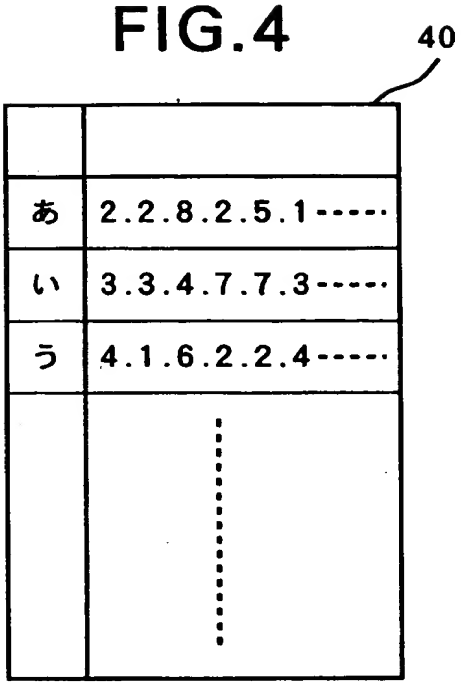


FIG.5

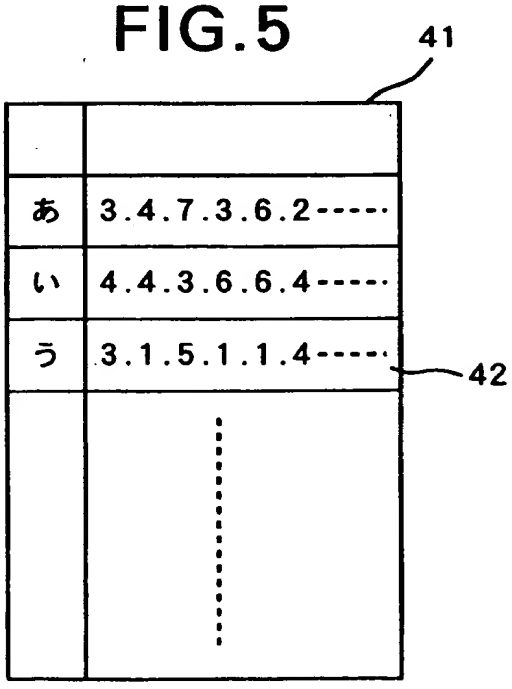


FIG.7

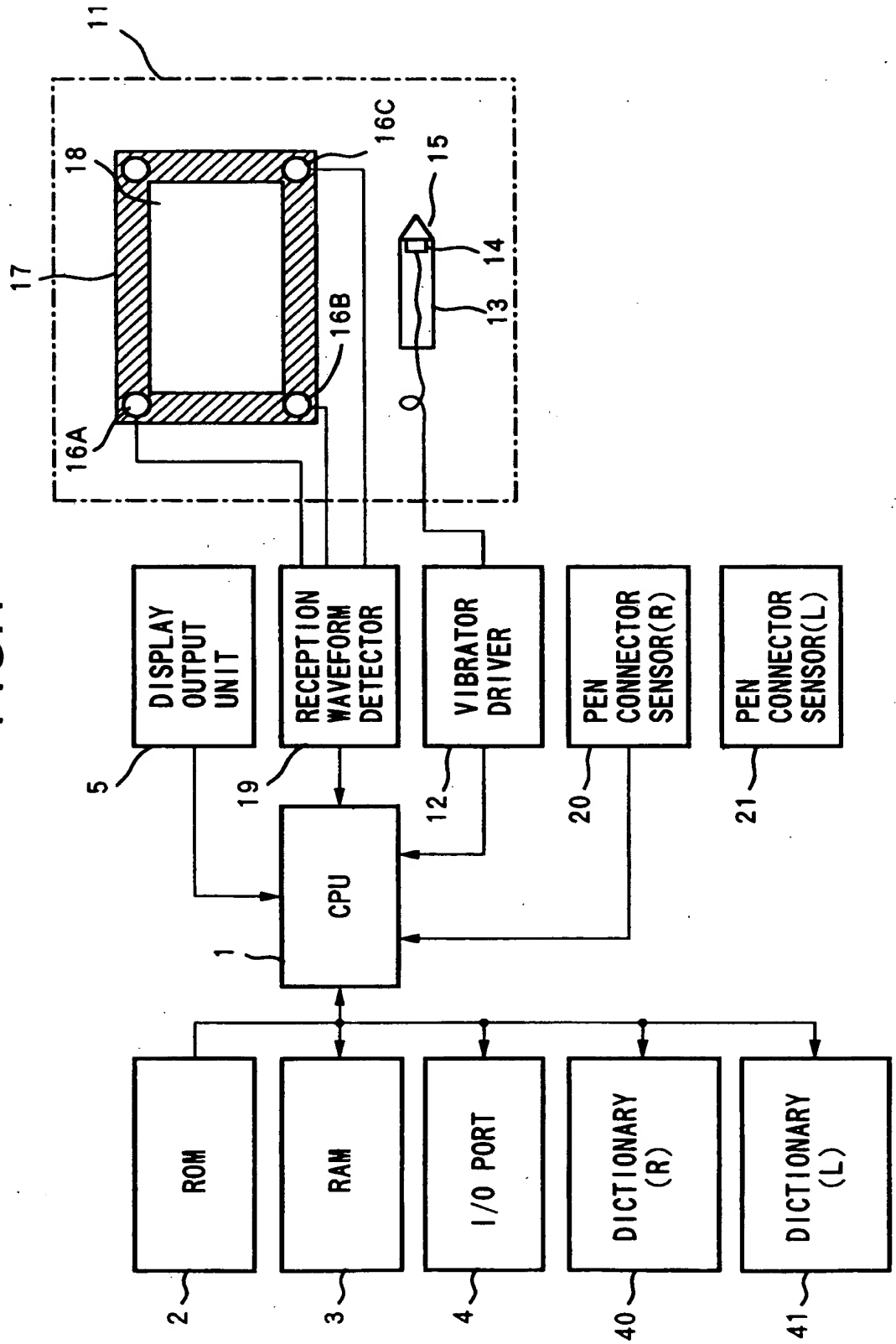

11
16C
18
15
17
14
13
16B
16A
Q
DISPLAY OUTPUT UNIT
RECEPTION WAVEFORM DETECTOR
VIBRATOR DRIVER
PEN CONNECTOR SENSOR(R)
PEN CONNECTOR SENSOR(L)
5
19
12
20
21
CPU
1
ROM
RAM
I/O PORT
DICTIONARY (R)
DICTIONARY (L)
2
3
4
40
41

FIG.9

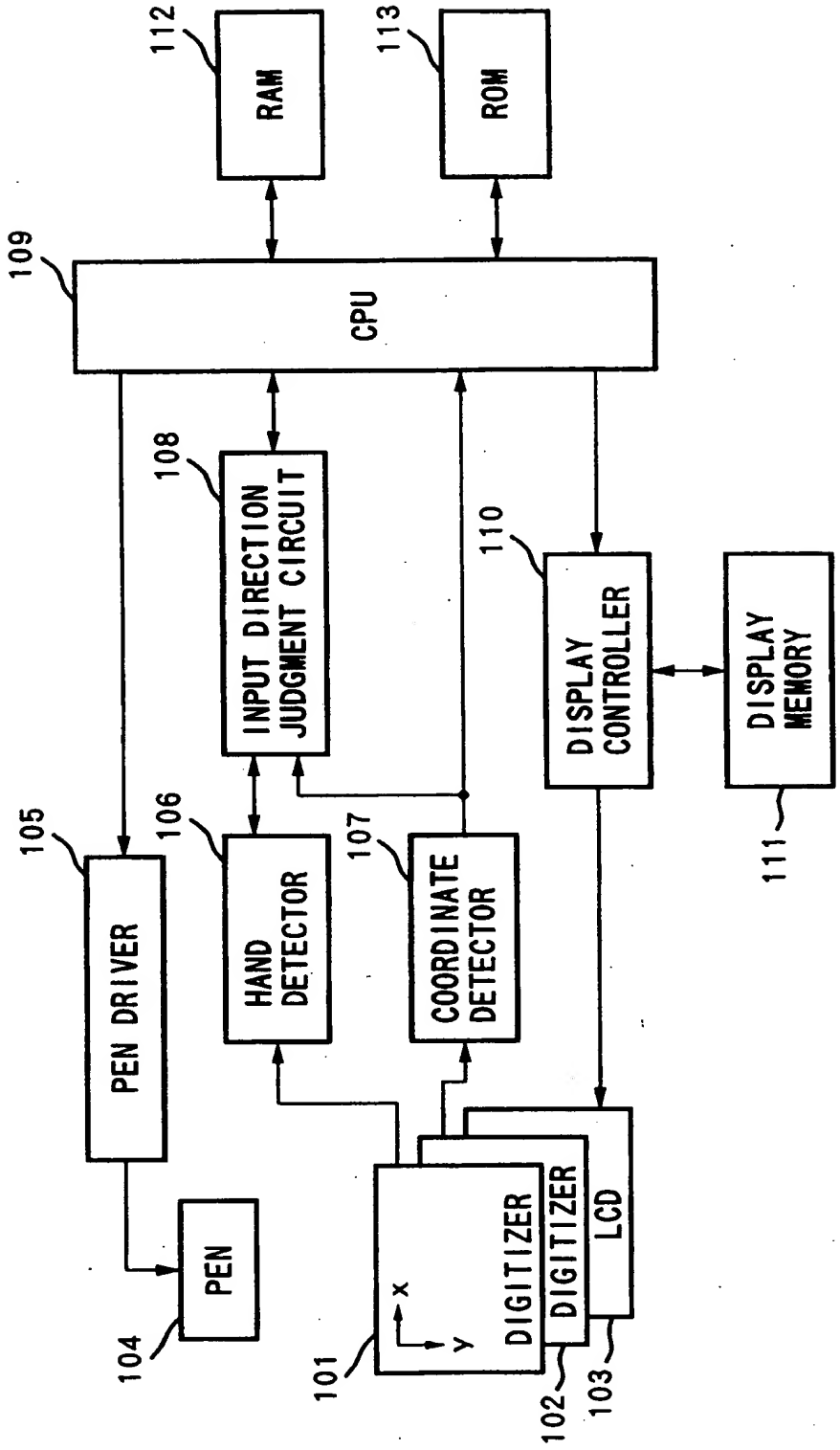

112
RAM
113
ROM
109
CPU
108
INPUT DIRECTION JUDGMENT CIRCUIT
110
DISPLAY CONTROLLER
DISPLAY MEMORY
111
105
PEN DRIVER
106
HAND DETECTOR
107
COORDINATE DETECTOR
PEN
104
x
y
DIGITIZER
DIGITIZER
LCD
101
102
103

FIG.11

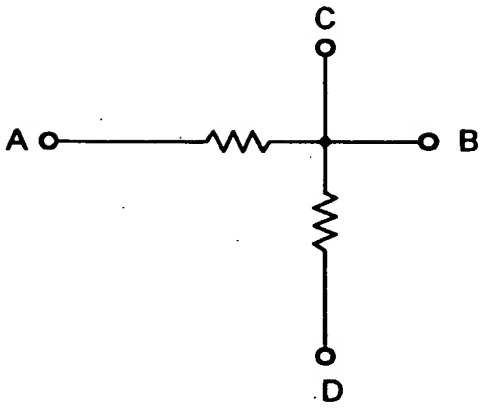


FIG.12

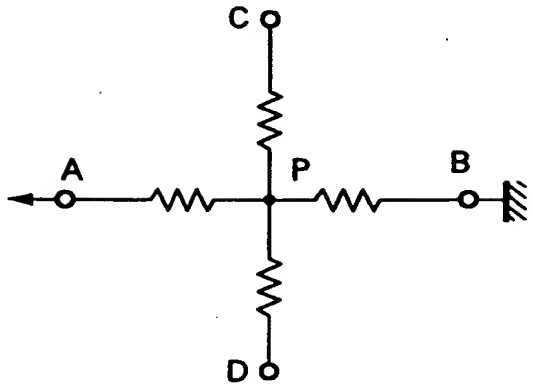


FIG.15

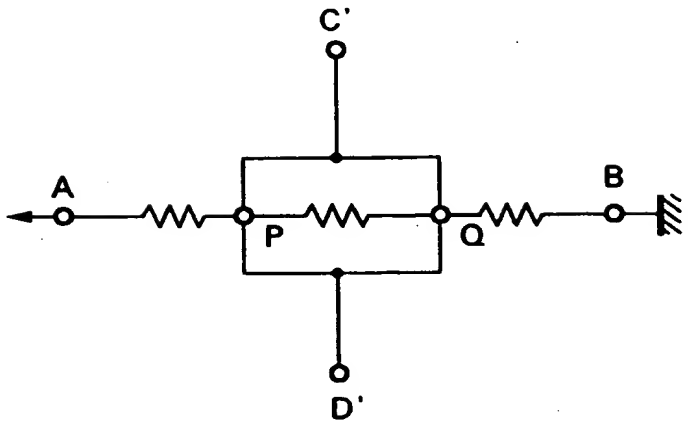


FIG.16

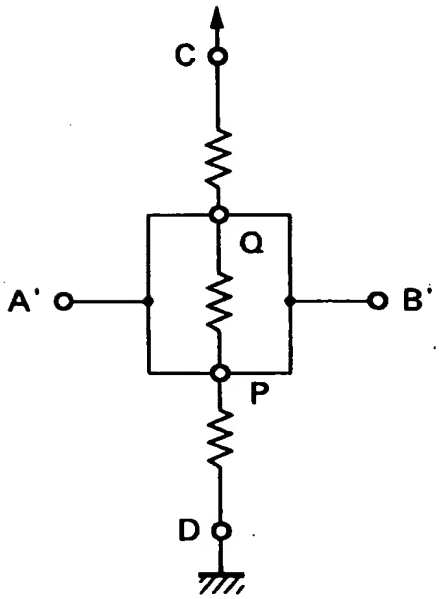


FIG.19

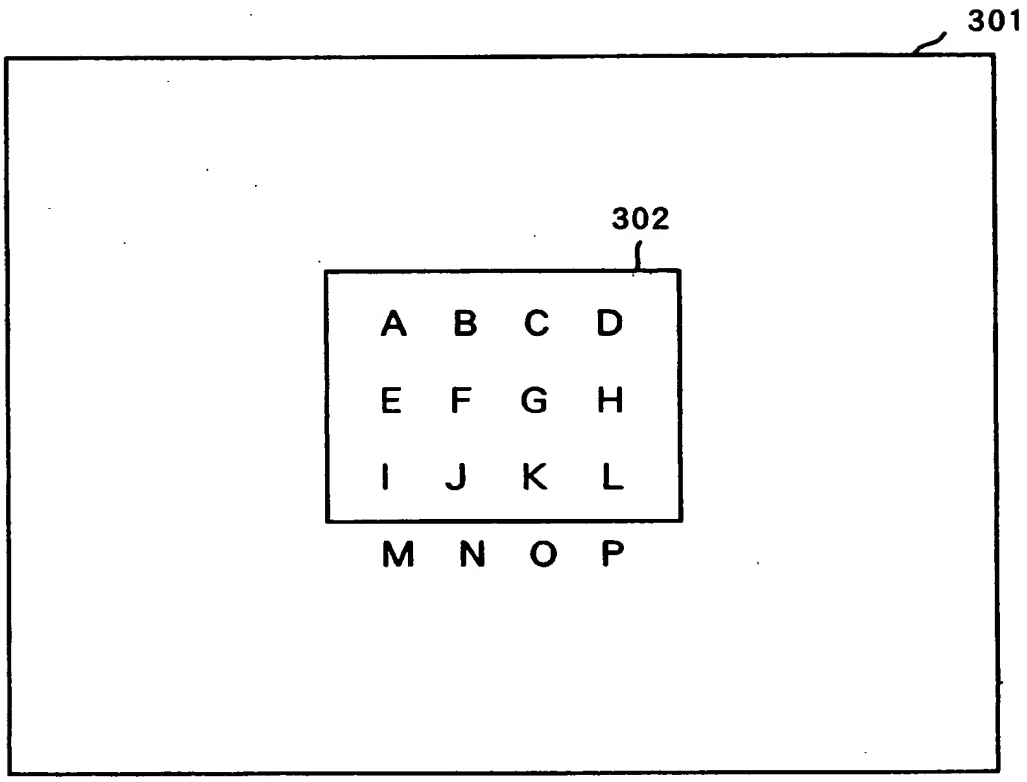


FIG.21

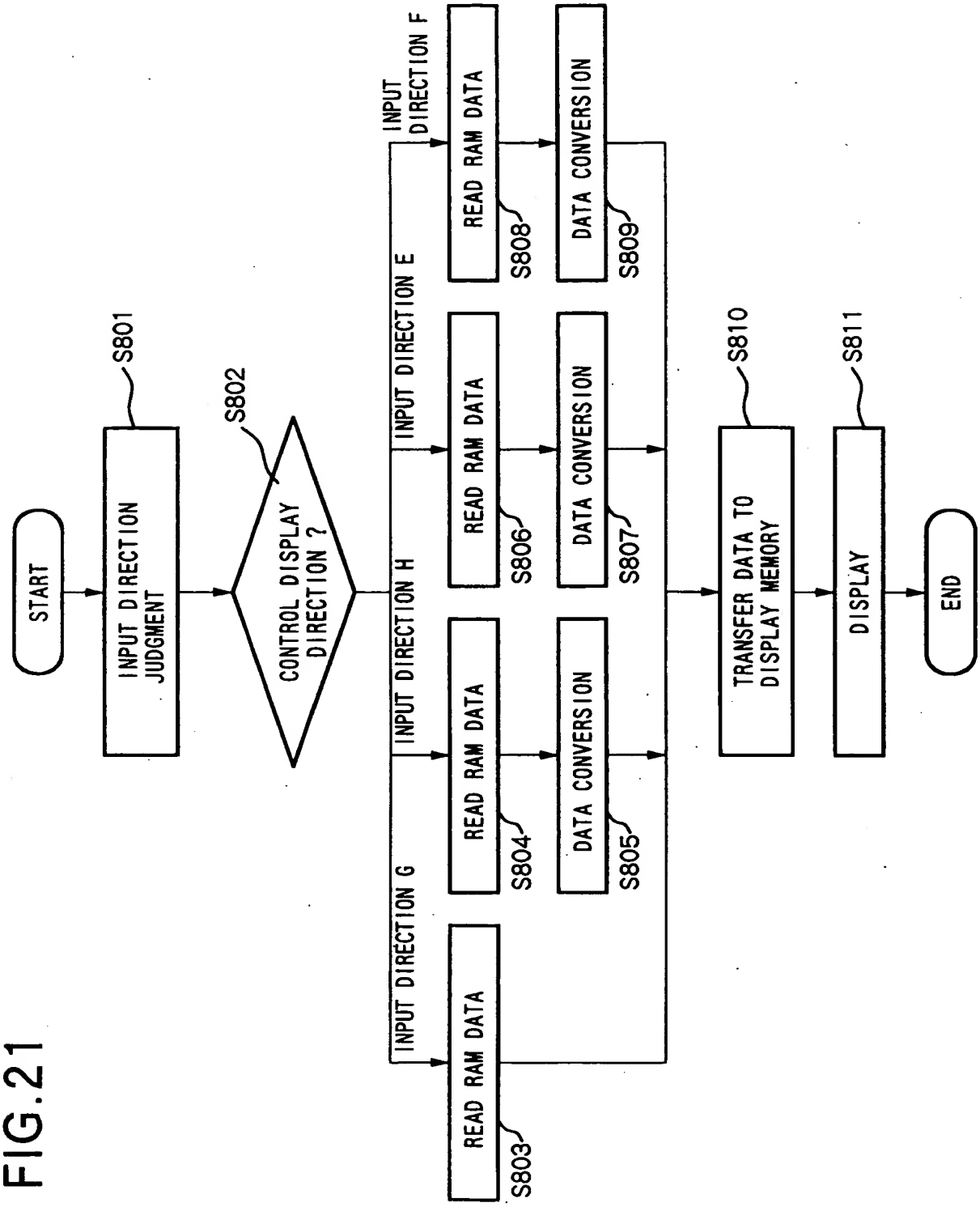

START
INPUT DIRECTION JUDGMENT
S801
CONTROL DISPLAY DIRECTION ?
S802
INPUT DIRECTION G
INPUT DIRECTION H
INPUT DIRECTION E
INPUT DIRECTION F
READ RAM DATA
S803
READ RAM DATA
S804
READ RAM DATA
S806
READ RAM DATA
S808
DATA CONVERSION
S805
DATA CONVERSION
S807
DATA CONVERSION
S809
TRANSFER DATA TO DISPLAY MEMORY
S810
DISPLAY
S811
END

FIG23

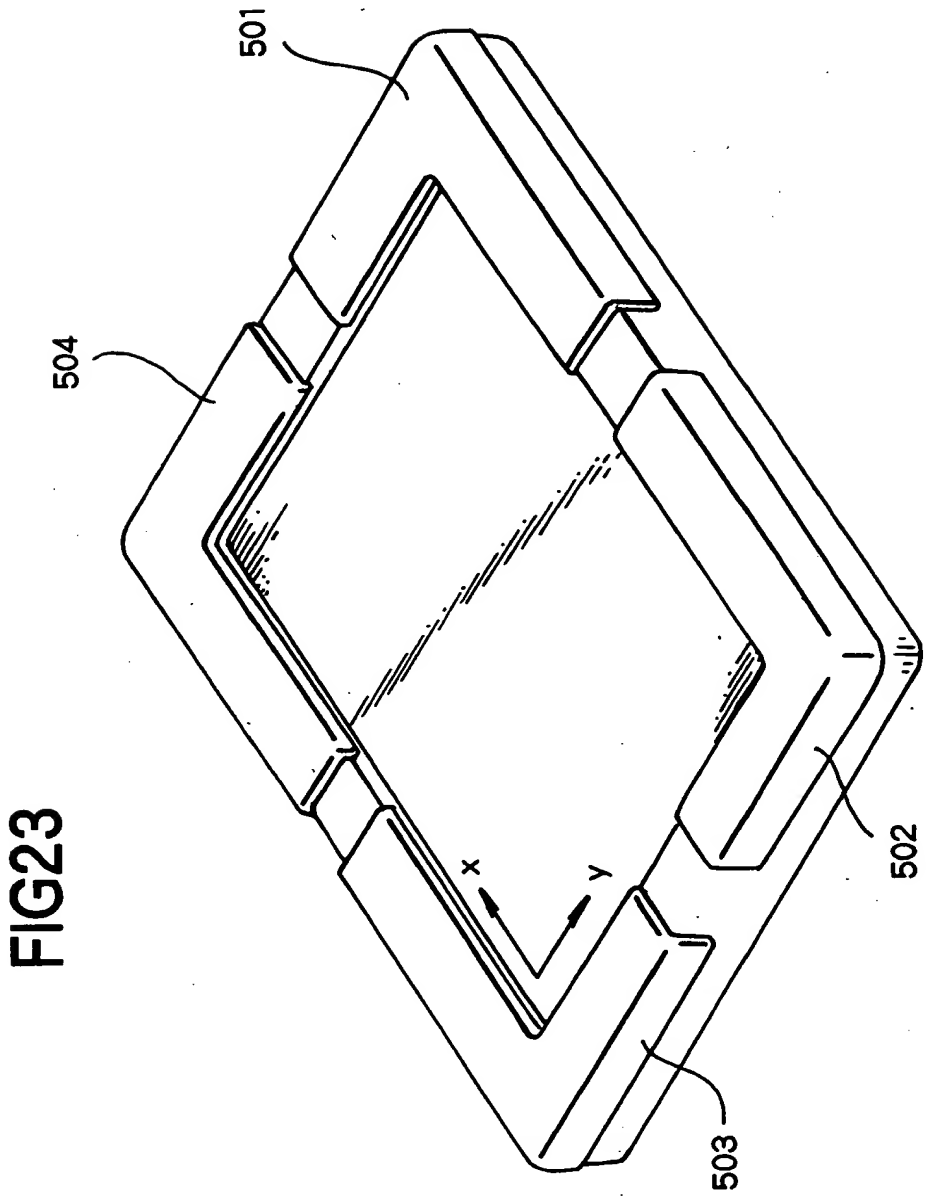


FIG.25

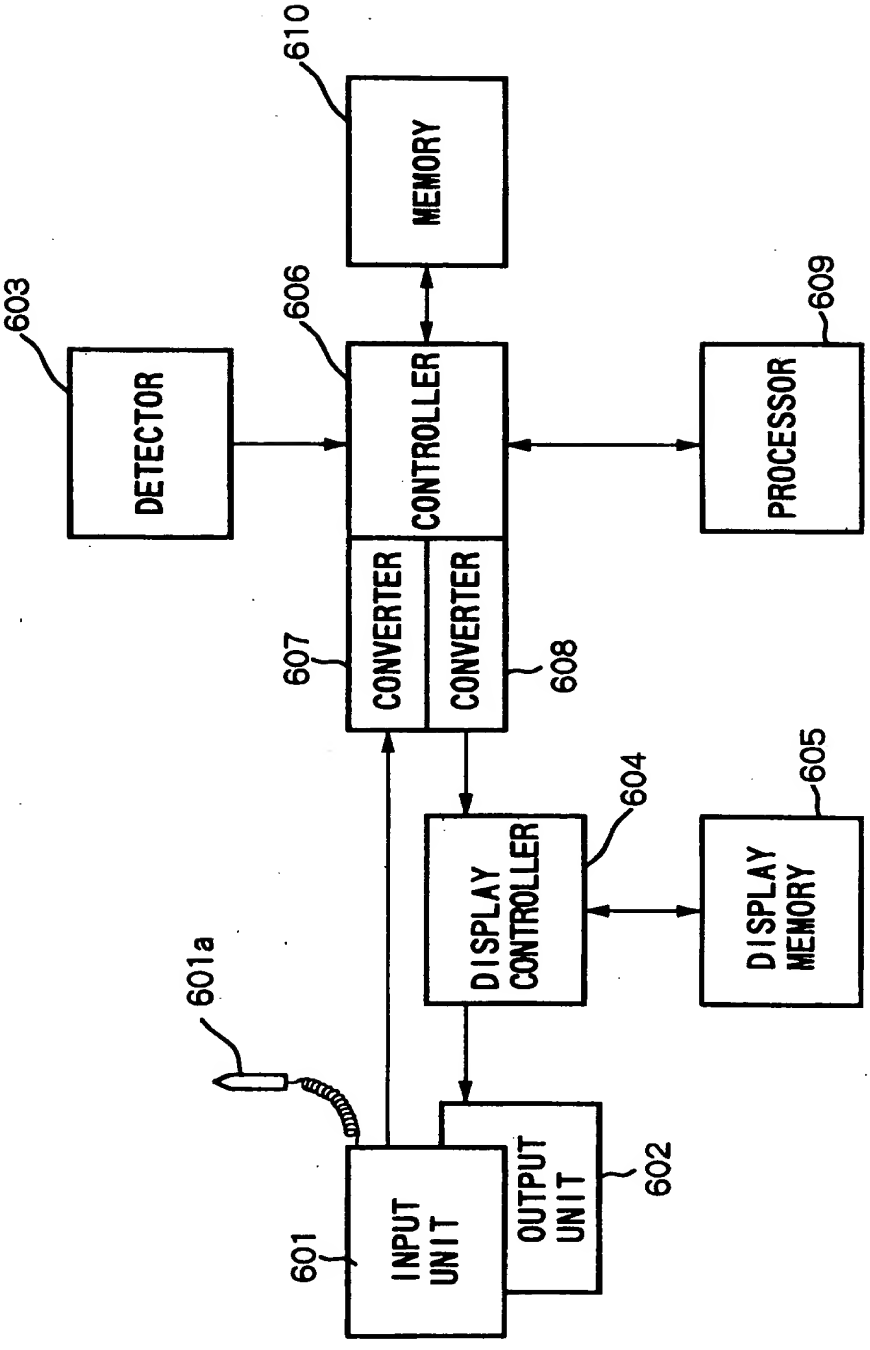
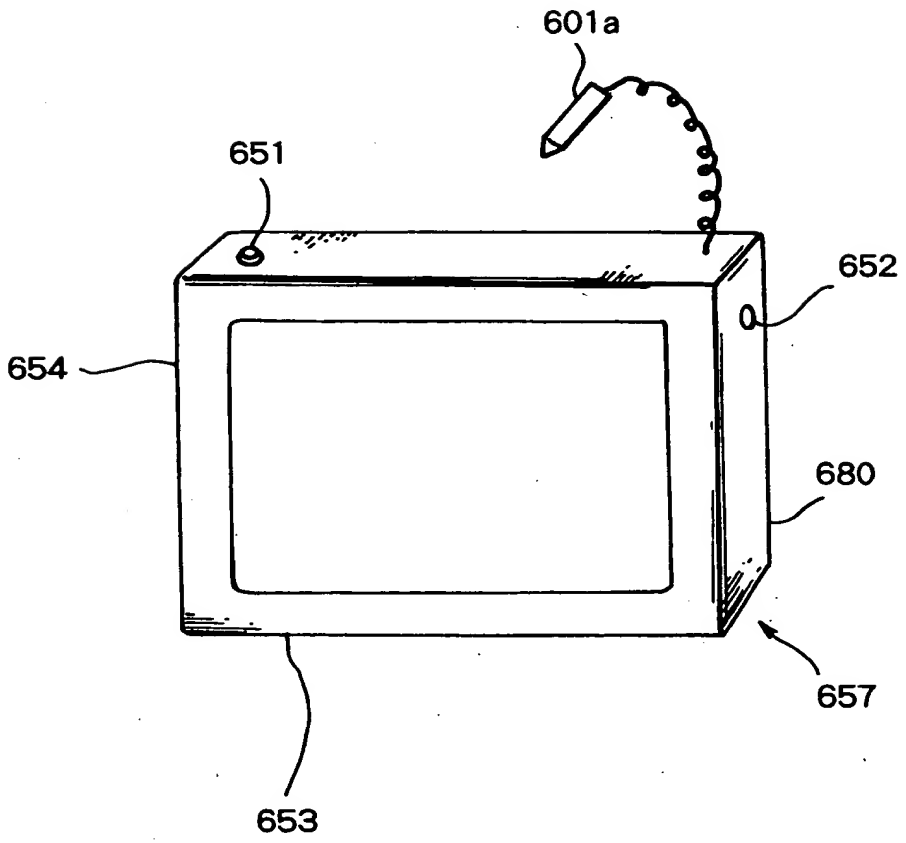

610
MEMORY
603
606
609
DETECTOR
CONTROLLER
PROCESSOR
CONVERTER
CONVERTER
607
608
604
605
DISPLAY CONTROLLER
DISPLAY MEMORY
601a
INPUT UNIT
OUTPUT UNIT
601
602

FIG.27



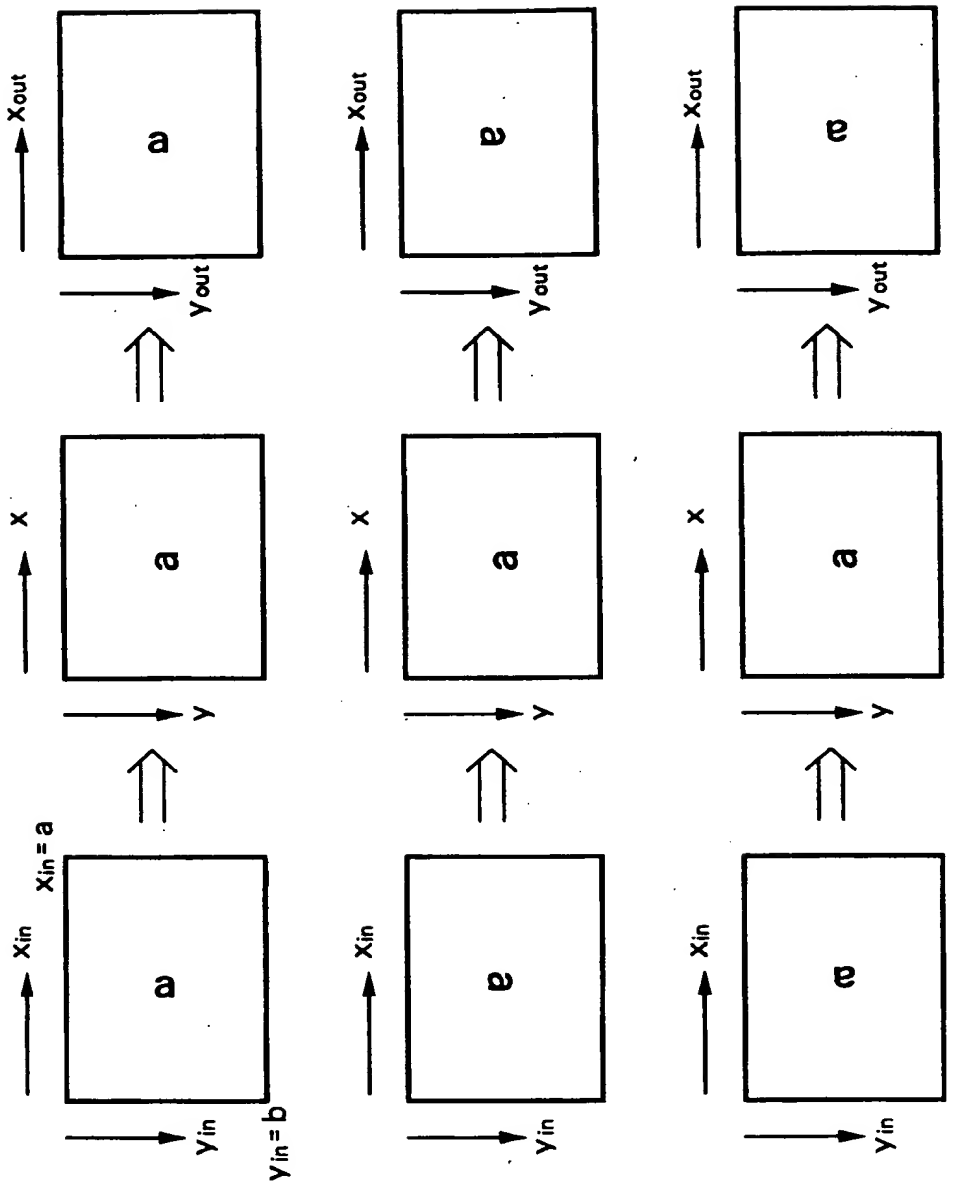


FIG.29A

FIG.29B

FIG.29C

FIG.31

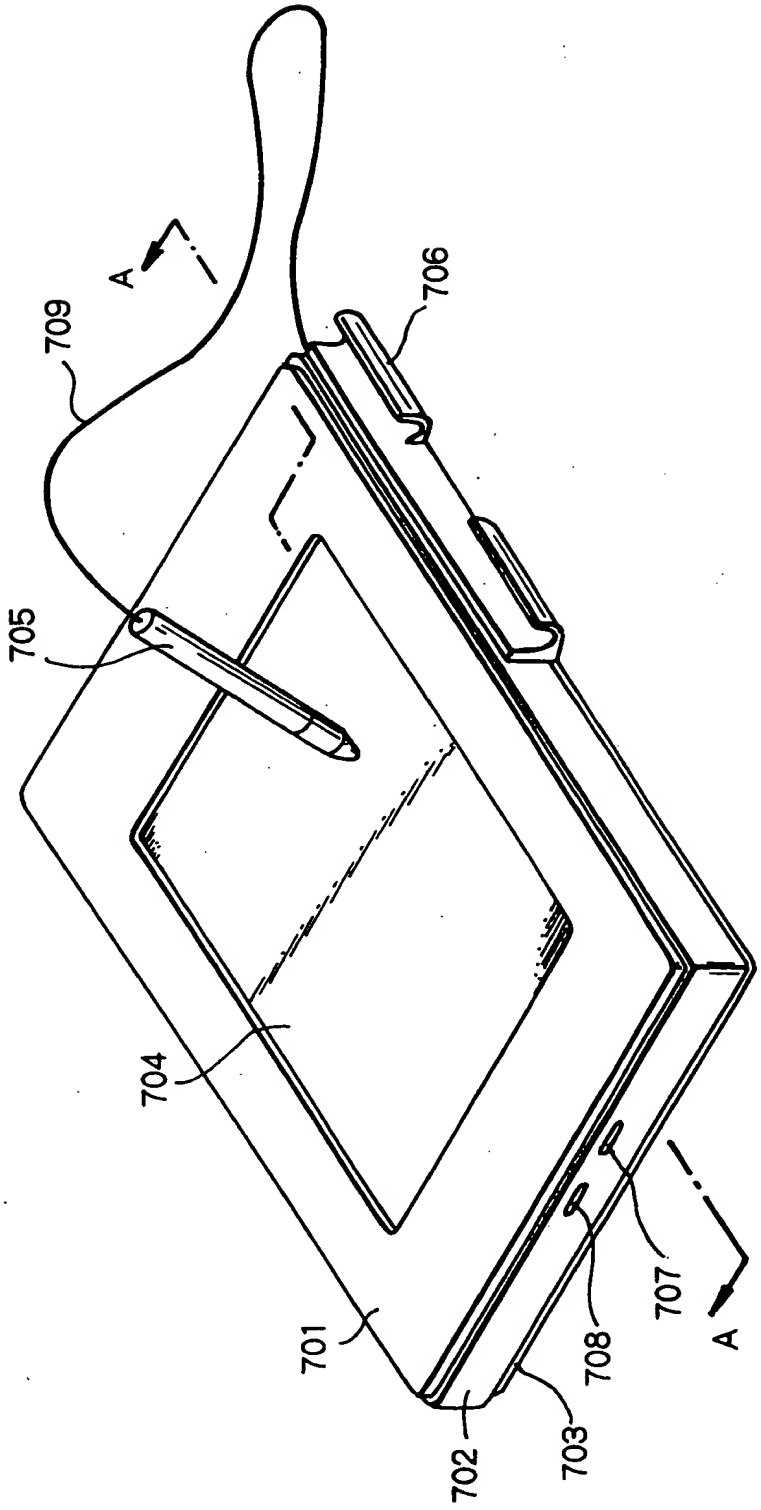


FIG.33

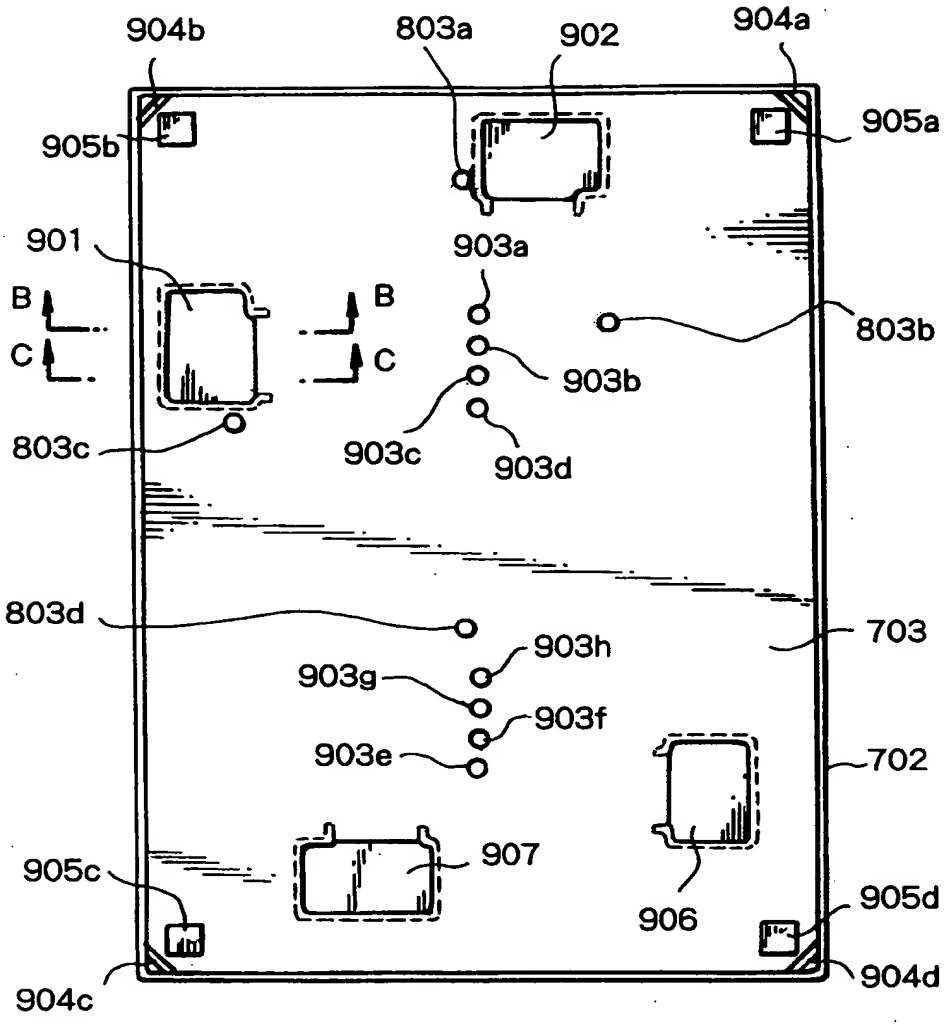

904b
803a
902
904a
905b
905a
901
903a
B
B
C
C
803b
903b
803c
903c
903d
803d
703
903h
903g
903f
903e
702
907
905c
906
905d
904c
904d

FIG.34

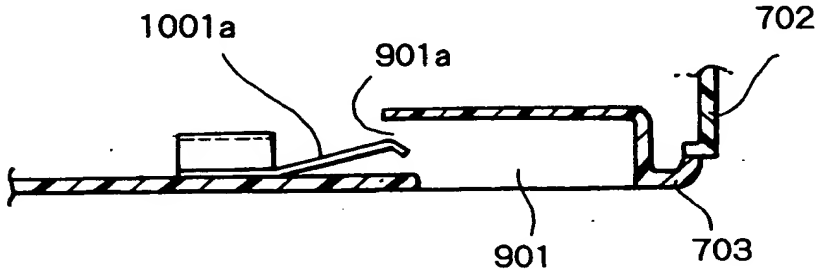

1001a
901a
702
901
703

FIG.37

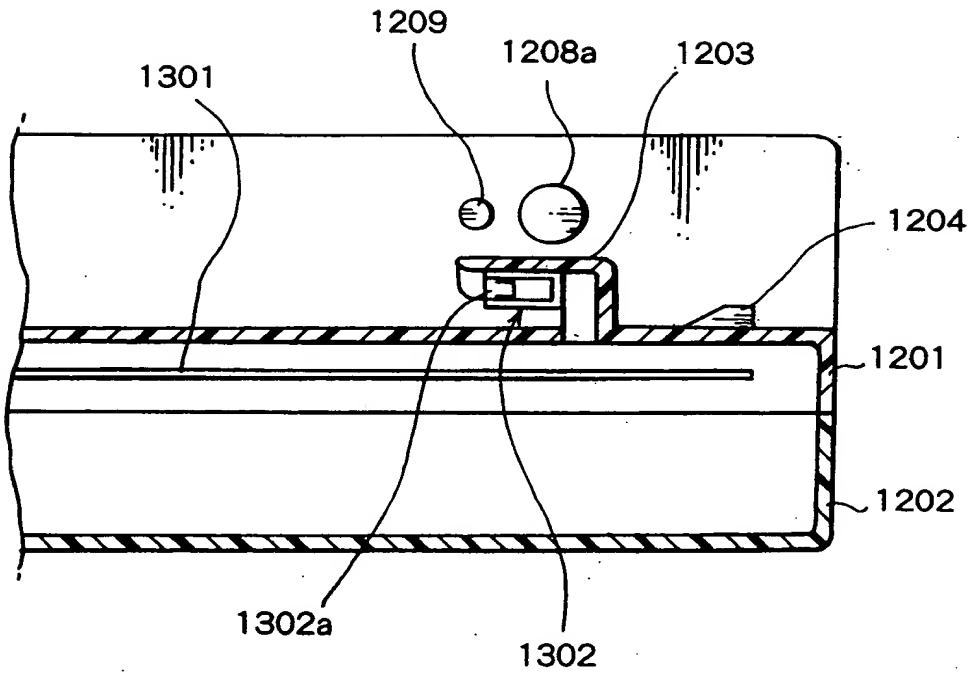


FIG.38C

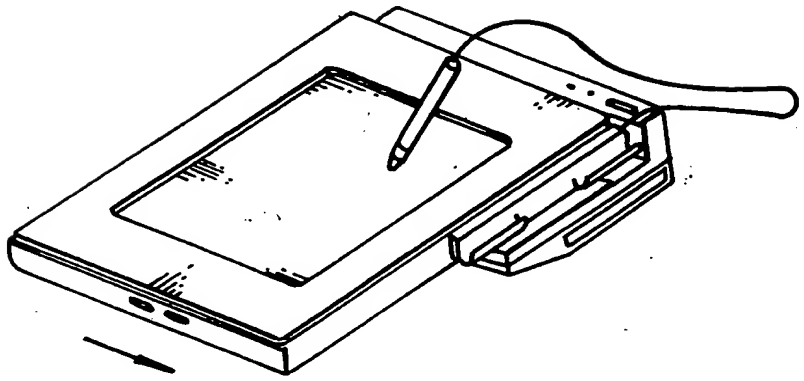


FIG.38D

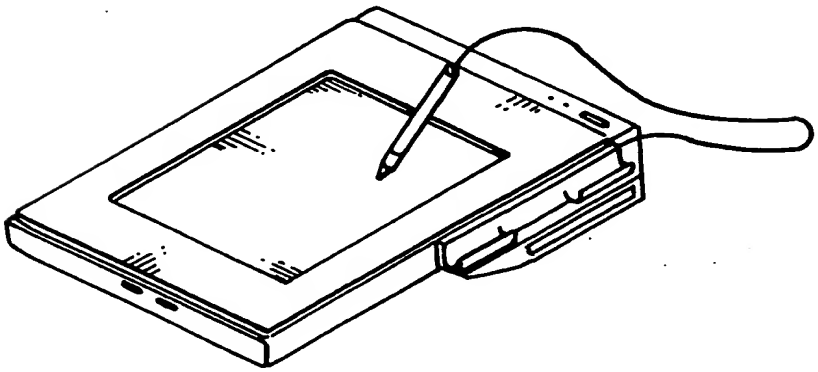


FIG.40

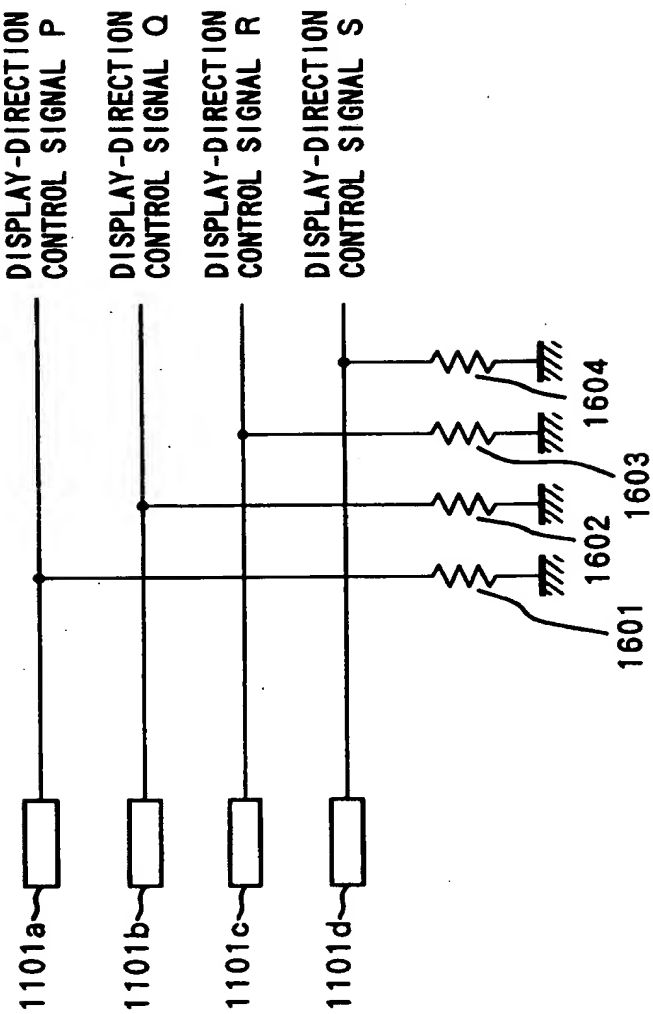

DISPLAY-DIRECTION CONTROL SIGNAL P
DISPLAY-DIRECTION CONTROL SIGNAL Q
DISPLAY-DIRECTION CONTROL SIGNAL R
DISPLAY-DIRECTION CONTROL SIGNAL S
1101a
1101b
1101c
1101d
1601
1602
1603
1604

FIG.42A

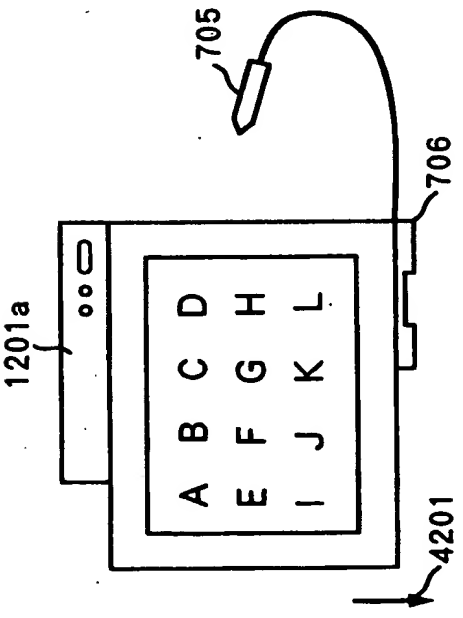


FIG.42B

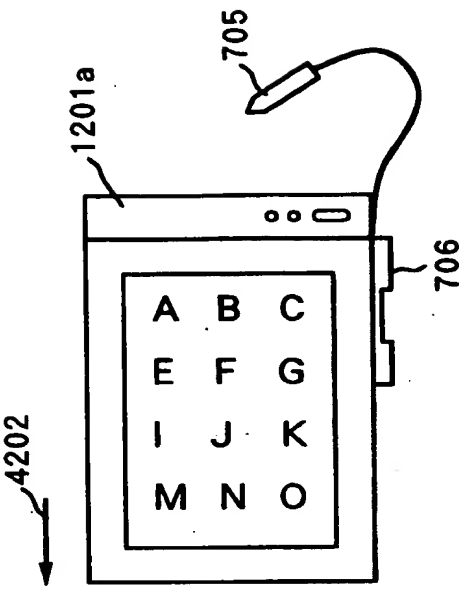


FIG.42C

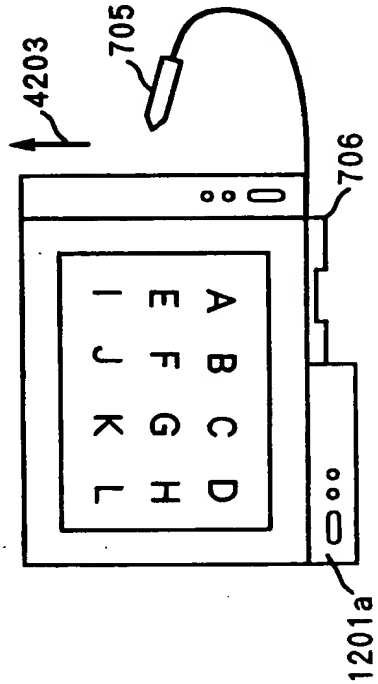


FIG.42D

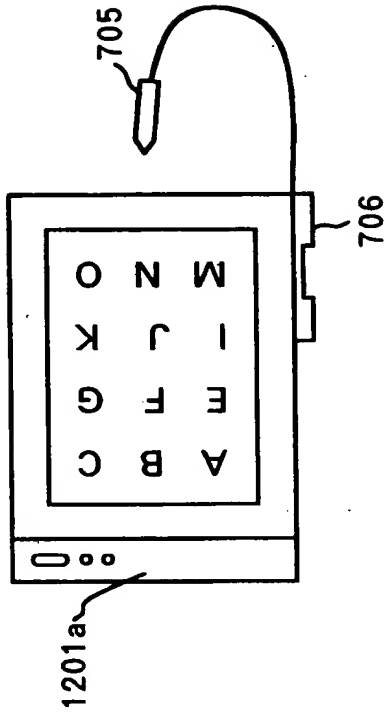


FIG.44

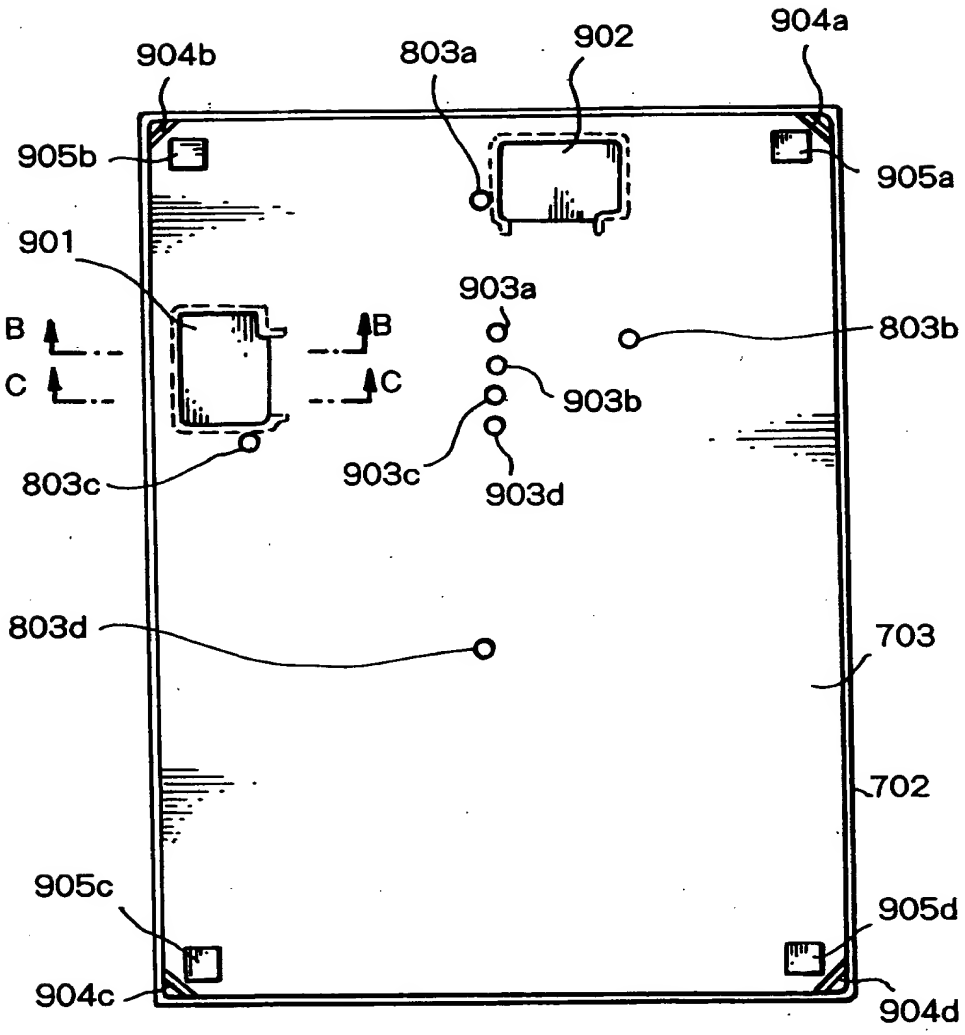

904b
803a
902
904a
905b
905a
901
903a
B
B
803b
C
C
903b
903c
903d
803c
803d
703
702
905c
905d
904c
904d

FIG.46

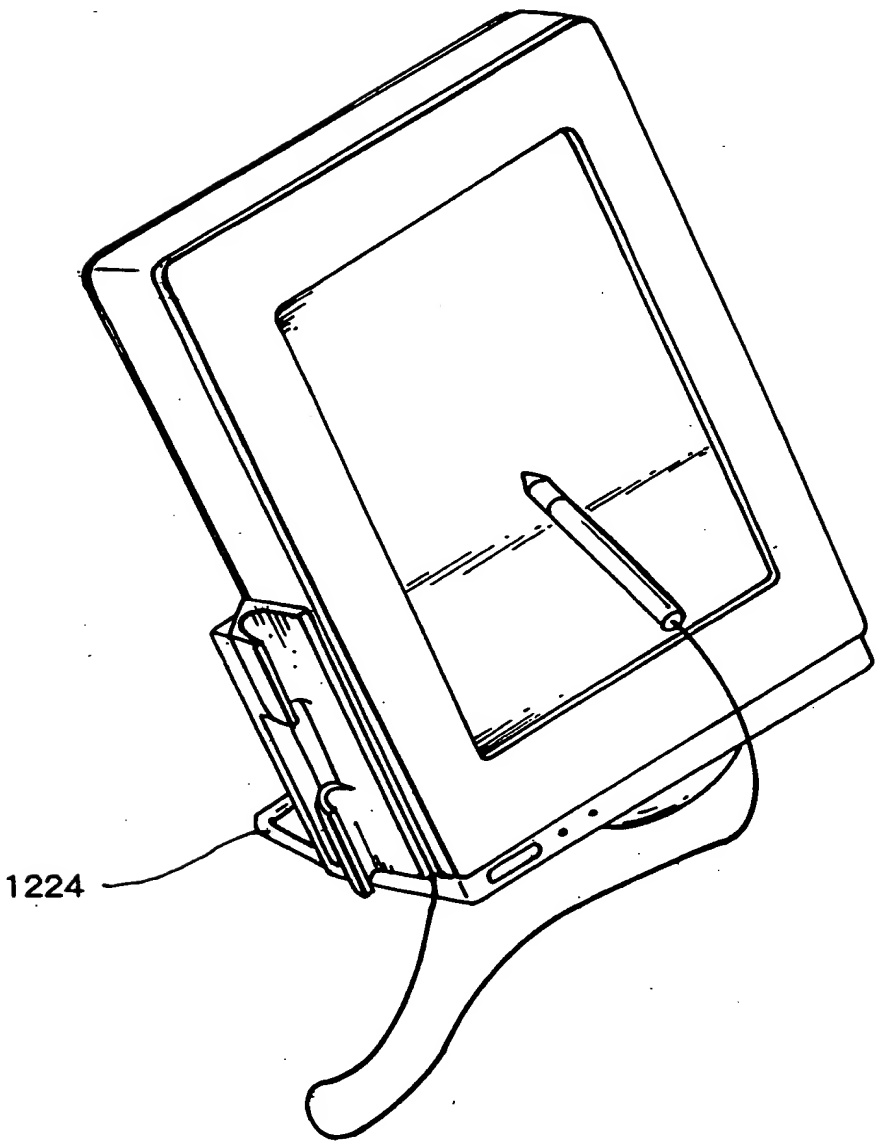


FIG.48

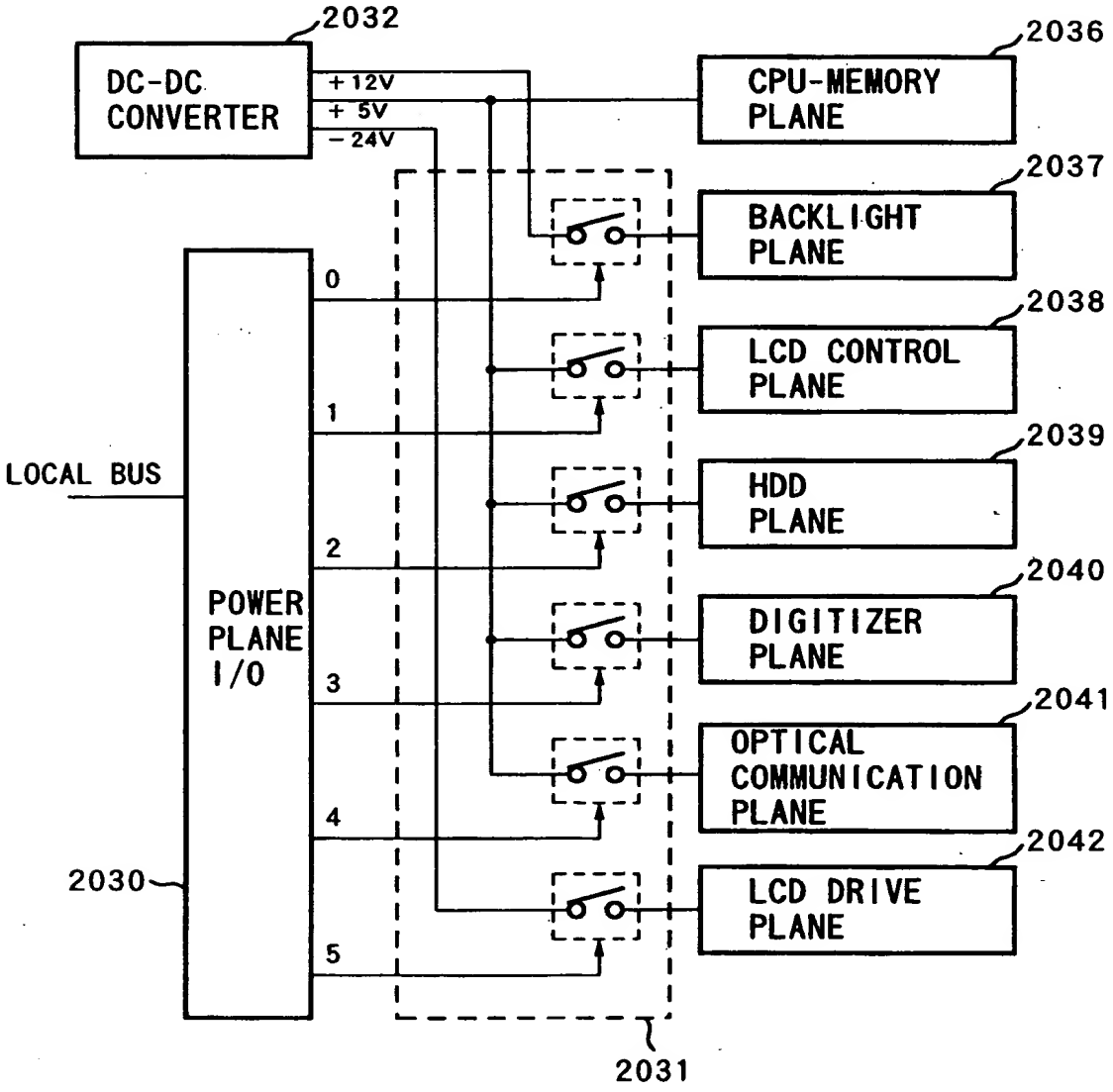

2032
DC-DC CONVERTER
+12V
+5V
-24V
2036
CPU-MEMORY PLANE
2037
BACKLIGHT PLANE
2038
LCD CONTROL PLANE
2039
HDD PLANE
2040
DIGITIZER PLANE
2041
OPTICAL COMMUNICATION PLANE
2042
LCD DRIVE PLANE
LOCAL BUS
POWER PLANE I/O
0
1
2
3
4
5
2030
2031

FIG.50

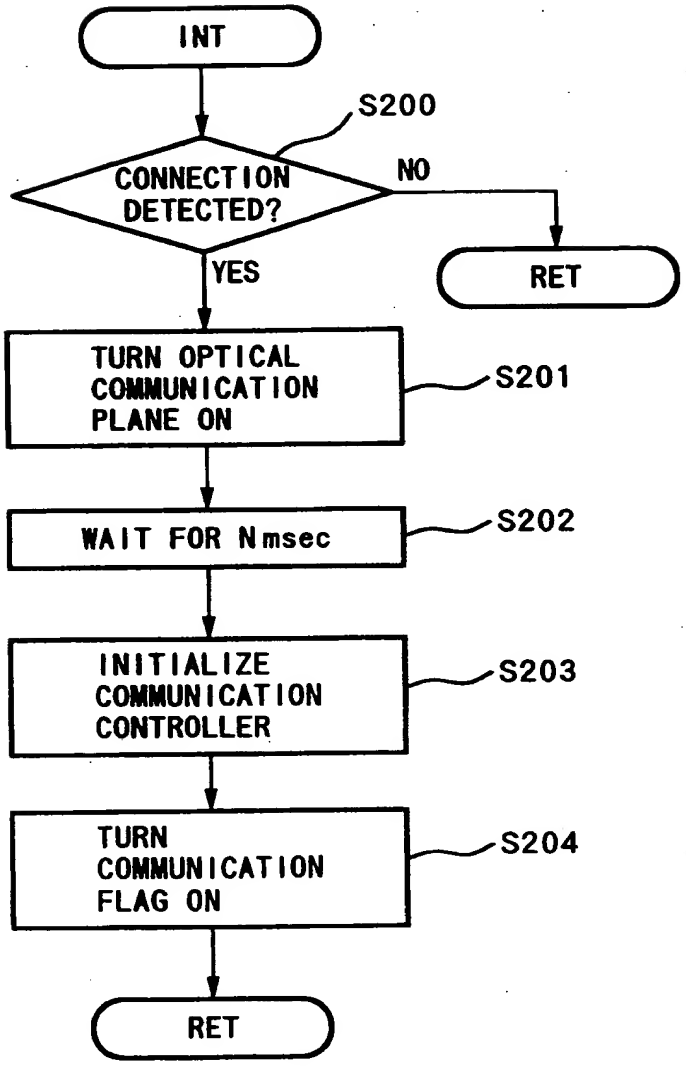

INT
S200
CONNECTION DETECTED?
NO
RET
YES
TURN OPTICAL COMMUNICATION PLANE ON
S201
WAIT FOR Nmsec
S202
INITIALIZE COMMUNICATION CONTROLLER
S203
TURN COMMUNICATION FLAG ON
S204
RET

FIG.52

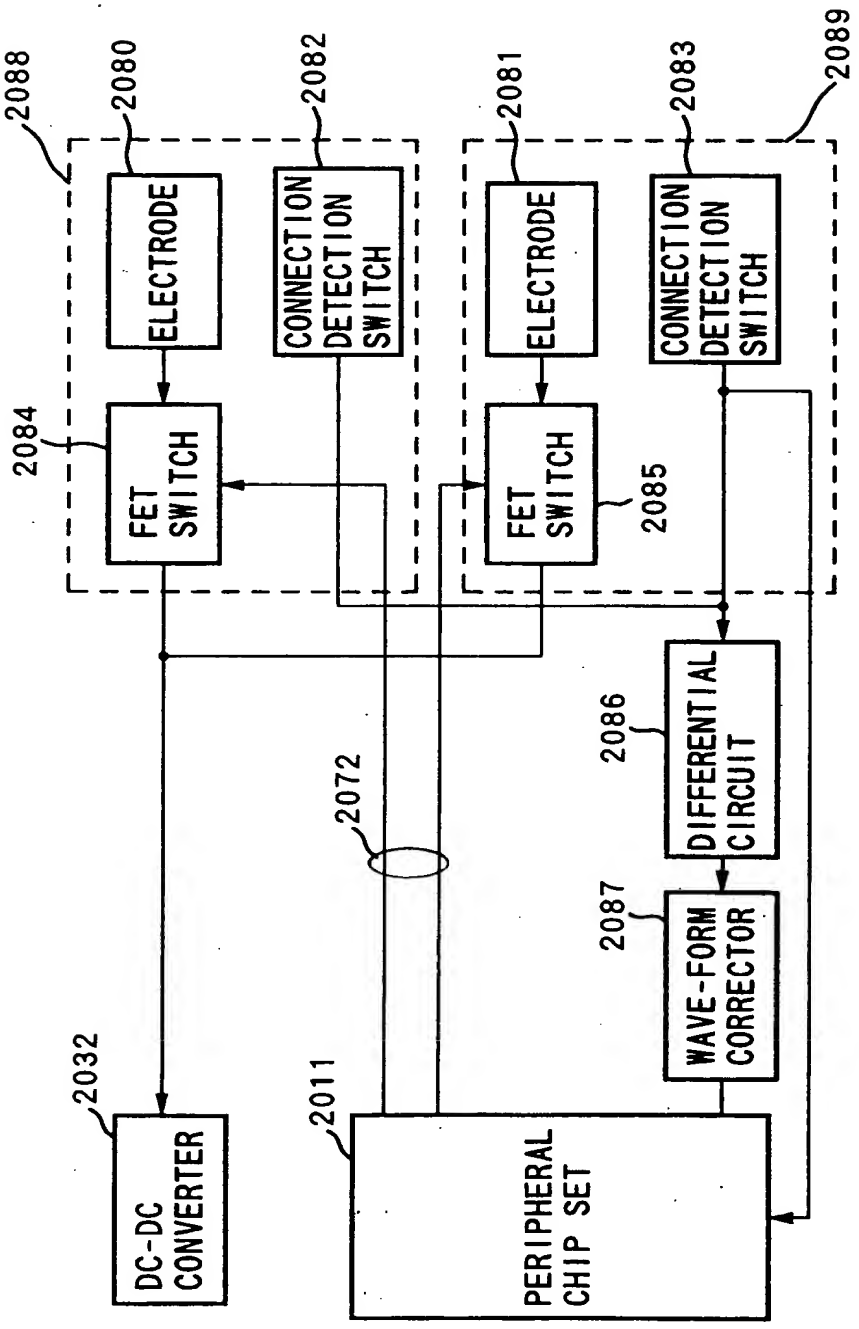

2088
2080
2082
2081
2083
2089
ELECTRODE
CONNECTION DETECTION SWITCH
ELECTRODE
CONNECTION DETECTION SWITCH
2084
FET SWITCH
FET SWITCH
2085
2086
DIFFERENTIAL CIRCUIT
2072
2087
WAVE-FORM CORRECTOR
2032
DC-DC CONVERTER
2011
PERIPHERAL CHIP SET

FIG.54

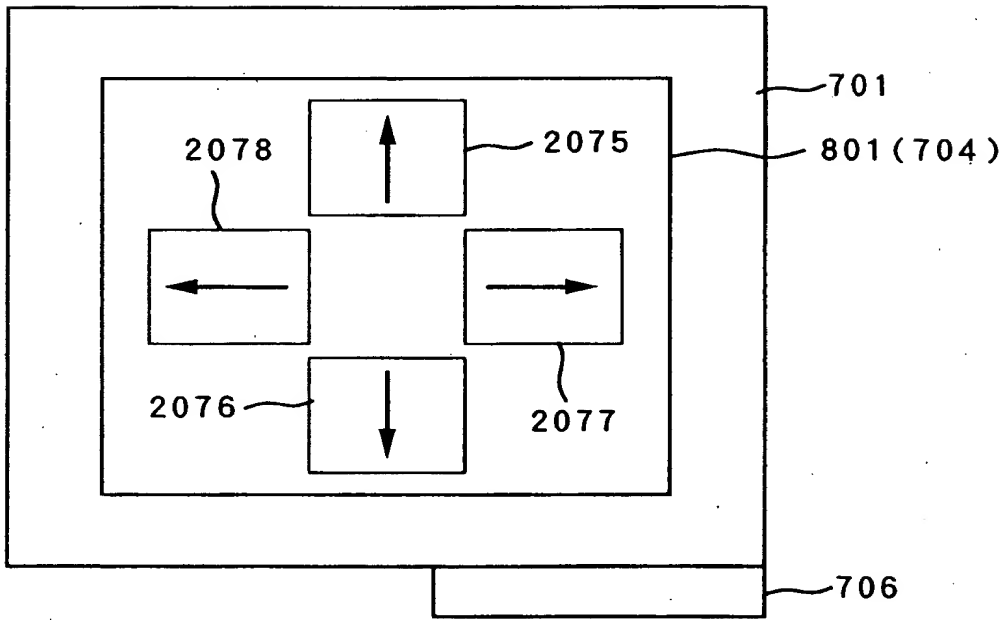


FIG.56A

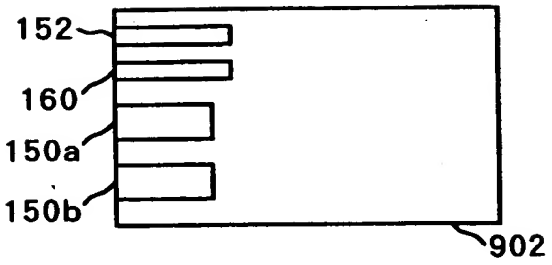


FIG.56C

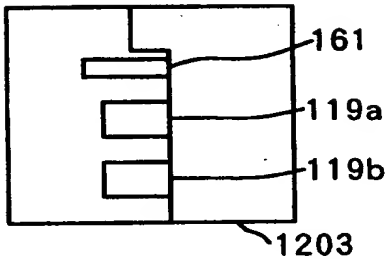


FIG.56B

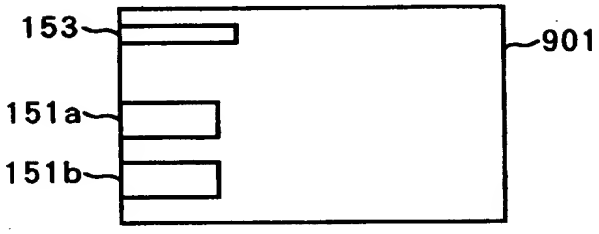


FIG.57

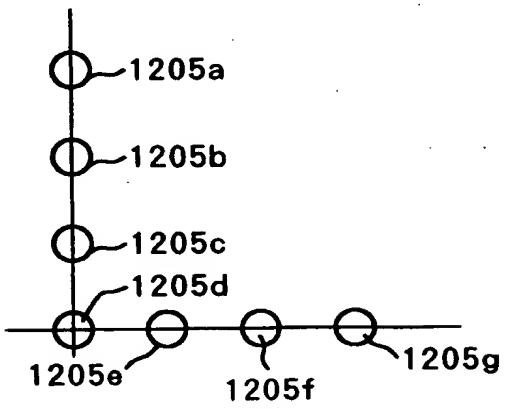


FIG.59

SELECTION SIGNAL LEVEL

CHANNEL		0	1
A	OUTPUT	c	e
	INPUT	d	d
B	OUTPUT	a	g
	INPUT	b	f

FIG.60